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PHYSICS ABSTRACTS

SECTION A

of

SCIENCE ABSTRACTS

SECTION A, PHYSICS

SECTION B, ELECTRICAL ENGINEERING

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ABSTRACTS 6240-6979

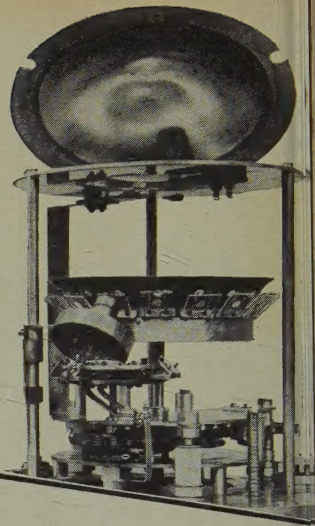
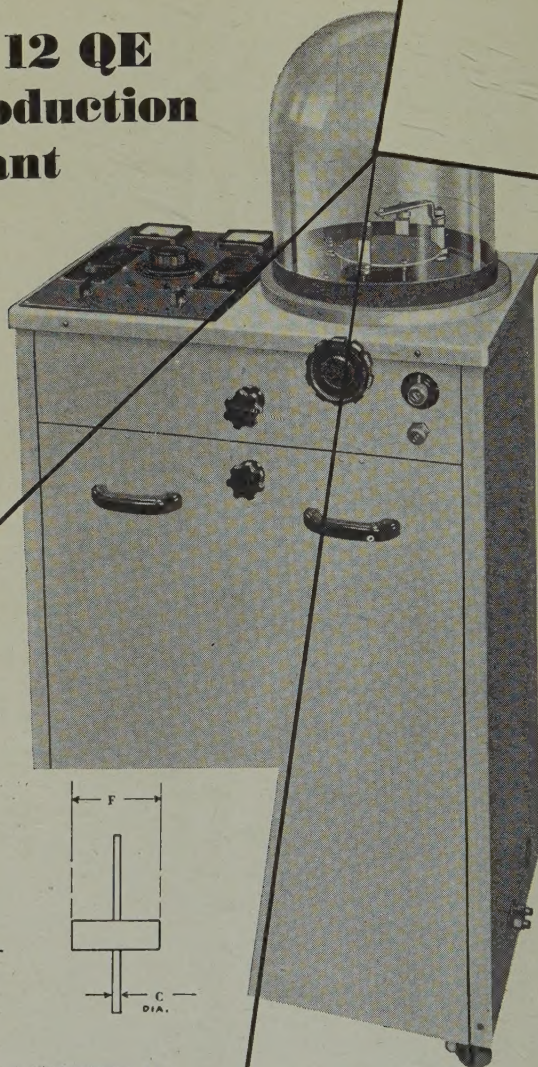
VOLUME 55

SEPTEMBER 1952

NUMBER 657

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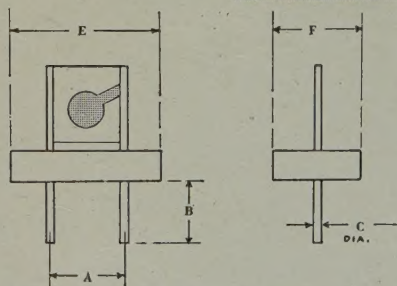
- A high deposition rate and a wide range of control which permits the adjustment of crystals already coated, or the complete coating and final adjustment in one operation.
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(INSET ABOVE)

Photograph of turret head of Model 12 QE with cover removed from work-chamber.

(CENTRE)

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SEPTEMBER 1952

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Mechanical testing	Automatic control mechanisms	Amplifiers
Non-destructive testing	Applied electrochemistry	Radiocommunication
Industrial radiography	Photocells	Mechanical engineering
Electrical and magnetic measurements and instruments	Thermionic tubes	Illumination
	Cathode-ray tubes	Metallurgy
Electronic relays and counters.	X-ray tubes	

LIST OF JOURNALS

The following list, together with the lists published in the preceding issues of the current volume, supplements the List of Journals published with the January number of Volume 53 (1950) and the Supplements published with the Indexes to Volume 53 (1950) and Volume 54 (1951). Reprints of the List of Journals (1950) and the Supplements (1950, 1951) can be obtained from The Institution of Electrical Engineers, Savoy Place, London, W.C.2, price 2s post free.

The addresses given are believed to be correct at the date of publication, but no responsibility can be accepted for errors.

Journals marked * are not received regularly.

- | | |
|--|--|
| BT-H Res. Lab. Publ. | British Thomson-Houston Research Laboratory Publication. British Thomson-Houston Company, Rugby. |
| BT-H Tech. Monogr. | British Thomson-Houston Technical Monograph. British Thomson-Houston Company, Rugby. |
| Bull. Inst. Met. | Bulletin of the Institute of Metals. [Issued as inset in Journal of the Institute of Metals.] 4 Grosvenor Gardens, London, S.W.1. |
| *Comm. Int. Eclair. [CIE] 12th Mtg, 1951 | International Commission on Illumination [CIE] 12th Meeting, 1951. Central Bureau C.I.E., 1860 Broadway, New York 23. |
| Fysisk Tidsskr. | Fysisk Tidsskrift. Selskabet for Naturlærens Udbredelse [Society for the Propagation of Natural Science.] Jul. Gjellerup's Boghandel, Solvgade 87, Copenhagen K. |
| *J. Appl. Physiol. | Journal of Applied Physiology. 2101 Constitution Avenue, Washington 25 D.C. |
| *J. Inst. Elect. Engrs Japan. | Journal of the Institute of Electrical Engineers of Japan [The Denki-Gakkai] No. 3, 1-Chome Yurako-Cho, Chiyoda-Ku, Tokyo. |
| New York Univ. (Wash. Sq. Coll.) Math. Res. Group, Res. Rep. | New York University, Washington Square College of Arts and Sciences Mathematics Research Group, Research Reports. Washington Square, New York 3. |
| Rev. RTT | Revue RTT. Régie des Télégraphes et Téléphones, 42 Rue des Palais, Bruxelles III. |
| Tekn. Fören. Finland Förh. | Tekniska Föreningens i Finland Förhandlingar. Svenska Teaterhuset, Helsinki. |
| *Tokyo Astron. Bull. | Tokyo Astronomical Bulletin. Tokyo Astronomical Observatory, Mitaka, Tokyo. |
| Trav. Soc. Sci. Varsovie VI. | Société des Sciences et des Lettres de Varsovie Classe VI: Sciences Techniques. Travaux Techniques. Pałac Staszica, Nowy Świat 72, Warsaw. |

New Journals

- | | |
|-----------------------|--|
| Direct Current | Direct Current. Garraway Ltd., 11A Kensington Church Street, London W.8. Vol. 1, No. 1 dated June, 1952. Quarterly. Subscription for 4 issues commencing with Vol. 1, No. 1: 16 shillings; \$2.25; 800 francs (Swiss). |
| Jodrell Bank Ann. | Jodrell Bank Annals [Astronomical Contributions from the University of Manchester, Series J]. Jodrell Bank Experimental Station, Holmes Chapel, Cheshire. Vol. 1, No. 1 dated April, 1952. "Publication in separate fascicles whenever accumulation of data warrants their appearance." No price quoted. |
| Mullard Tech. Commun. | Mullard Technical Communications. Century House, Shaftesbury Avenue, London, W.C.2. First issue dated May, 1952. "Other issues will appear from time to time." |

Changes of Address

- | | |
|--|--|
| Ingegneri
J. Electrodepos. Tech. Soc. | L'Ingegneri. Via F. Civinini 37, Rome.
Journal of the Electrodepositors' Technical Society. 32 Great Ormond Street, Holborn, London, W.C.1. |
| Proc. Nat. Inst. Sci. India | Proceedings of the National Institute of Sciences of India. Mathura Road, New Delhi. |

Errata

- Author Index (1950), p. 1102, column 1, line 1: for GOLDMAN, J., read GOLDMANN, J.
- Author Index (1950), p. 1151, column 1, line 68: for CLUIUS, K., read CLUSIUS, K.
- Abstr. 9738 (1951), line 3: for HAWSLEY read HAWKSLEY.
- Abstr. 1113 (1952), line 2: for V. I. VERKIN read B. I. VERKIN.
- p. 508 (1952) column 2, line 19: for Abstr. 4278 read Abstr. 4728.
- Abstr. 4220 (1952), line 5: delete "R.C.A."
- Abstr. 4512 (1952), line 2: for SCHULER, K. E., read SHULER, K. E.

MATHEMATICS 51

518.5 : 535.33.087.9

6240. A semi-automatic graphical computer with use in spectroscopy. G. L. WEISSLER, A. W. EINARSSON AND J. D. MCCLELLAND. *Rev. Sci. Instrum.*, **23**, 209-12 (May, 1952).

The device described is a development of Beals' intensitometer [Abstr. 1740 (1944)] in which a photographic characteristic curve is followed manually by an operator. It is capable of transforming semi-automatically a microphotometer density v . wavelength trace into an intensity trace, and in the same manner the logarithms or antilogarithms of a variable can be graphically computed. In addition, the machine can take the differences of two curves and plot the results either directly or logarithmically or antilogarithmically, or in a way appropriate to any specific problem. It is possible to evaluate, for instance, in successive steps all the quantities in Beer's law of absorption, $I = I_0 \exp(-kx)$, as a function of wavelength. A detailed example is presented to illustrate its operation.

A.

518.5 : 621.318.572

6241. Universal high-speed digital computers: a decimal storage system. T. KILBURN AND G. ORD. *Instn. Elect. Engrs Paper* 1325, 10 pp. [Early Proof Issue].

Describes 3 methods of storing decimal digits, which are extensions of the well-known method of storing binary digits using a c.r.t. store. It is shown that one of these methods which uses 10 separate but small elements of the c.r.t. screen, provides the best compromise between speed of operation, digit storing capacity and reliability. A complete serially-controlled c.r.t. store holding 32 words of 8 decimal digits has been operated successfully. The digit period was 40 μsec , and could be conveniently reduced to 30 μsec if desired. It is shown that the preferred decimal system may be derived from a new binary system of storage.

A.

518.5 : 621.318.572

6242. A simple electronic digital computer. W. L. VAN DER POEL. *Appl. Sci. Res. B*, **2**, 367-400 (No. 5, 1952).

The machine is experimental and not intended as a

practical computer, the logic of its operation being set out without technical details. Numbers are handled in binary form using the one-address code, addition and subtraction being the only operations. Programming of various problems is given in great detail; this is simple, there being only 7 instructions. Both magnetic drum and mercury delay lines have been used as memories. Operation is very slow, but speed has been deliberately sacrificed for extreme simplicity.

A. J. KENNEDY

519.24

6243. Statistical errors in measurements on random time functions. W. B. DAVENPORT, JR. AND R. A. JOHNSON AND D. MIDDLETON. *J. Appl. Phys.*, **23**, 377-88 (April, 1952).

The statistical errors in time-average measurements of various properties of (stationary) random time functions are analysed for their dependence on the averaging interval, the method of averaging, and the statistics of the particular time function under observation. The specific averaging processes considered here are: (1) The continuous time average

$\left(\frac{1}{T} \int_0^T Z(t) dt\right)$. (2) The summation (by discrete sampling techniques) $\left(\frac{1}{N} \sum_{n=1}^N Z(nT_0)\right)$. (3) The smooth-

ing accomplished by various low-pass filters (for example, a d.c. meter). Here $Z(t)$ may represent the output of a linear or non-linear device. As a particular example, the measurement of the power in a random noise voltage of bandwidth ω_F is analysed in detail. The expected root-mean-square error approaches asymptotically the value $(K/\omega_F T)^{1/2}$, where K is some numerical constant, depending on the device in question. For (1) and (2) T is the total observation time, while for (3) it is proportional to a relevant time constant of the low-pass filter. A short discussion of the relative merits of correlators and spectrum analysers is included, together with a brief treatment of the distribution function of the error in the measurement.

A.

ASTRONOMY . ASTROPHYSICS . GEODESY 52

523.165

6244. Galactic noise. J. G. BOLTON. *U.R.S.I. Proc. IXth Gen. Assembl.*, **8**, 364-9 (Pt II, 1950).

Summary of present state of the subject, considering especially the general background of galactic noise as diluted radiation of a distribution of radio stars, and applications of noise measurements to problems of the structure of the Galaxy.

G. M. BROWN

523.165 : 621.396.11 : 621.396.82

6245. Planetary position effect on short-wave signal quality. J. H. NELSON. *Elect. Engng [N.Y.]*, **71**, 421-4 (May, 1952).

Has been studied by investigating the effects of all planets from Mercury to Saturn when any two or more are separated by heliocentric angular relationships of 0, 90, 180 or 270 degrees. Correlation was

found between the degradation of transatlantic s.w. signals and these planetary configurations, especially for a "multiple of 90 degrees" arrangement, for example, when two planets are at 0 degree with each other, and a third planet is 90 or 180 degrees away. The duration of the degradation depends on the speed of the planets, and the effect is complicated if more than three planets form "multiple of 90 degrees" arrangements simultaneously. Examples are given of such correlation for the years 1948–51, together with the severity and duration of the effect in these cases.

A. A. LINSSELL (R)

523.35

6246. A new investigation of an atmosphere in the neighbourhood of the moon. A. DOLLFUS. *C.R. Acad. Sci. [Paris]* **234**, 2046–9 (May 19, 1952) *In French*.

The polarization of the diffused light beyond the horns of the crescent moon has been examined with the coronagraph and an interference polariscope. It is concluded that the density of any lunar atmosphere is less than 10^{-9} that of the terrestrial atmosphere.

M. W. OVENDEN

523.5

6247. Radio echo observations of the daytime meteor streams in 1951. G. S. HAWKINS AND M. ALMOND. *Jodrell Bank Ann.*, **1**, 2–12 (April, 1952).

Observations of the daytime meteor streams have been continued at Jodrell Bank during 1951. Radiant positions have been obtained for the η Aquarid, α Cetid, Arietid, ζ Perseid, and β Taurid streams, which have appeared in previous years. A new minor stream has been detected near ν Pisces. An ephemeris is given for the daily motion of the Arietids and ζ Perseids. Velocity distributions were also obtained for these streams and the computed orbital elements confirm their short periods. Measurements of stream and sporadic meteor activity are given for each day of the summer period.

A.

523.72

6248. Analysis of observations of solar radio emissions on 555 Mc/s and 255 Mc/s at the Observatory of Meudon during 1949 and 1950. M. LAFFINEUR. *U.R.S.I. Proc. IXth Gen. Assembl.*, **8**, 379–80 (Pt II, 1950) *In French*.

Note on study of bursts of radiation. Solar eruptions accompanied by radio emissions are situated near spots possessing a magnetic field greater than those which do not give radio bursts, and they show a preference for the solar quadrants N.E. and S.W. Short bursts also appear to be correlated with micro-eruptions observed visually in H α light.

G. M. BROWN

523.72

6249. The position and movement on the solar disc of sources of radiation at a wavelength of about 3 metres. R. PAYNE-SCOTT AND A. G. LITTLE. Summary in *U.R.S.I. Proc. IXth Gen. Assembl.*, **8**, 380–1 (Pt II, 1950).

Short summary of results of instantaneous measurements of the apparent position on the solar disk, and polarization, of sources of solar radiation at 97 Mc/s. It is suggested that the radio source is situated high in the corona above the associated sunspot group. The former appears to travel faster than

the latter. The same is true for radio bursts associated with flares.

G. M. BROWN

523.74

6250. On the dependence of the systematic drift of sunspots in heliographic latitude on phase in the 22-year cycle of the sun. J. TUOMINEN. *Z. Astrophys.*, **33**, 261–74 (No. 4, 1952).

The positions of the long-lived sunspot groups in Greenwich Observations from 1874 to 1936 have been used in order to study whether the speed of the systematic drift of the spots in heliographic latitude varies with phase in the 22-year cycle of the sun. The shape of the drift curves and the mean errors of the speeds seem to indicate that a dependence of phase possibly exists. Corresponding changes might be expected to be found in the law of solar rotation.

523.77

6251. A solar prominence bright in projection on the disk. H. W. DODSON AND E. R. HEDEMAN. *Letter in Observatory*, **72**, 30–1 (Feb., 1952).

A brief description of the visual and photographic observations of the development of a bright limb prominence on May 21, 1951, and the associated minor flare.

M. W. OVENDEN

523.75 : 537.591 : 538.566.3 : 550.388

6252. The chromospheric eruption of November 19, 1949, and its geophysical consequences. R. BUREAU AND A. DAUVILLIER. *U.R.S.I. Proc. IXth Gen. Assembl.*, **8**, 322–8 (Pt II, 1950) *In French*.

Account of remarkable chain of geophysical events following a solar flare—radio fade-out, solar radio noise, magnetic crochet, and strong solar emission of cosmic rays (3.6 increase %). The latter phenomenon [see also Abstr. 2556 (1950)] is discussed in relation to theories of the origin of cosmic rays.

G. M. BROWN

523.77

6253. The atom of heavy hydrogen and the spectrum of the sun. J. GAUZIT. *C.R. Acad. Sci. [Paris]* **234**, 1951–3 (May 12, 1952) *In French*.

Wavelengths of deuterium lines from Moore's table suggest the possible identification of the second members of the Balmer and Paschen series in the solar spectrum as shown in the atlases of Utrecht and McMath–Hulbert. The number of D atoms in these two levels are computed from the equivalent widths and assuming an excitation temperature of 5500° give 2×10^{19} and 5×10^{19} cm $^{-2}$ normal D atoms above the photospheric layer, implying that the relative abundance of heavy to ordinary hydrogen is not greater in the sun than in the earth.

D. L. EDWARDS

523.77

6254. Probable identification of forbidden infrared lines of neutral nitrogen in the solar spectrum. J. GAUZIT. *C.R. Acad. Sci. [Paris]* **234**, 2156–7 (May 26, 1952) *In French*.

Accurate wavelengths computed from new energy values by Edlen give two satisfactory identifications in Babcock and Moore's table and the McMath–Hulbert atlas of the solar spectrum. Equivalent widths (measured from the atlas), with assumed temp. of 5000°, yield the surprisingly high value of 4×10^{21} cm $^{-2}$ for the number of normal N atoms in the solar atmosphere.

D. L. EDWARDS

523.852.3

6255. On the masses and luminosities of extra-galactic nebulae. E. HOLMBERG. *K. Fysigr. Sällsk. Lund Förh.*, 22, 13 pp. (No. 5, 1952).

A method is suggested for determining the mass of an extra-galactic nebula from its absolute magnitude, the basic assumption being that the mass corresponding to a certain luminosity mainly depends on the stellar content of the system, that is, on the ratio of type I to type II stars. A study of the mass data available for the present indicates that the quotient mass/lum. is intimately related to the latter ratio, as represented by the integrated colour index. An application of the method to the material of nearby nebulae investigated by the writer in 1950 leads to several interesting results. Thus, the mean logarithmic mass corresponding to a given volume of space does not seem to be larger than 8.5.

A.

523.852.32

6256. A diffraction corona near the centre of the spiral nebula NGC 4216. B. LINDBLAD AND A. ELVIUS. *Nature [Lond.]* 169, 1042-3 (June 21); Erratum, 170, 61 (July 12, 1952).

Asymmetry of light distribution about the central region, in yellow, blue and u.v., has been measured in the barred spiral, NGC 4216, and found to result from diffraction by a thin layer, mean particle radius, 0.3μ . Results are well reproduced using theoretical computations of Blumer (1925, 1926) for dielectric particles, $n = 1.25$.

D. R. BARBER

523.852.33

6257. Magellanic clouds. III. Differential absorption within the large cloud. IV. On the period frequency anomalies. H. SHAPLEY AND V. MCK. NAIL. *Proc. Nat. Acad. Sci. [Wash.]* 38, 281-9 (April, 1952).

Continuation of previous investigations [Abstr. 5041-2 (1951)]. Based on period-luminosity relation, study of Cepheid variables in 6 selected regions of the Large Cloud indicates min. total absorption of 0.23 mag. in central (axis) zone of cloud. A striking difference in frequency distribution of periods is found for Large and Small Clouds. In the L.M.C. only 3 of a total of 195 periods are $< 2d$, whereas in the S.M.C. 135 periods out of 536 are $< 2d$ —a % ratio of 1/17.

D. R. BARBER

523.873

6258. Spectroscopic study of Wolf-Rayet stars in the near infrared. Y. ANDRILLAT. *C.R. Acad. Sci. [Paris]* 234, 2154-6 (May 26, 1952) *In French*.

Low dispersion spectra of 4 WC and 6 WN stars show (in addition to normal features) strong emission lines of N II in the WC stars, while numerous lines of C and O in different degrees of ionization are found in WN stars. The need for a revised classification is emphasized.

D. L. EDWARDS

523.877

6259. The determination of a model stellar atmosphere from the intensities of absorption lines. J.-C. PECKER AND H. VAN REGEMORTER. *C.R. Acad. Sci. [Paris]* 234, 1850-2 (May 5, 1952) *In French*.

The equivalent width of a stellar absorption line, for the centre of the stellar disk, is given by

$$W = 5.28 \times 10^6 \cdot g f \lambda^2 A \int_0^\infty [g(\tau)/x_0] f(T, p_e, \chi) \phi(x, a) d\tau,$$

where τ is the optical depth, $g(\tau)$ a weight function, $\phi(x, a)$ the saturation function, and f a function of temperature T , electron pressure p_e and excitation potential χ which has been given in an earlier paper [Claas, *Rech. Astr. Obs. Utrecht*, 12, 1 (1951)]. For weak lines, $\phi = 1$; for strong lines, ϕ is small; for intermediate cases, ϕ depends upon the degree of turbulence. W is thus replaced by an expression freed from the effects of turbulence, $W'(\chi) =$

$$5.28 \times 10^5 \cdot g f \lambda^2 A \int_0^\infty \exp(-\chi/kT) F(T, p_e, \tau) d\tau.$$

From the relation between W' and χ for each element, the function F is found by least squares as a function of T . An assumed function $T(\tau)$ yields $p_e(\tau)$. A new least-squares solution yields an improved $T(\tau)$, and hence $T(\tau)$ and $p_e(\tau)$ are found by successive approximations. The use of W as well as W' gives information of the degree of turbulence at each optical depth. No examples are given, but preliminary results are stated to be encouraging.

M. W. OVENDEN

523.877

6260. Large-scale motions of ionized calcium in the atmosphere of a giant star. A. MCKELLAR, G. J. ODGERS, L. H. ALLER AND D. B. MC LAUGHLIN. *Nature [Lond.]* 169, 990-2 (June 14, 1952).

Spectrophotometric obsns. of the eclipsing binary, 31 Cygni, during atmospheric eclipse of the B-component by the K-type central star reveal, particularly at egress, transitory line-structure of the Ca K-line which appears most pronounced from c. 2 to 4 weeks after totality, weak absorption components of varying displacement and intensity being present. It is suggested that the observations are evidence of prominence-like activity in the outer atmosphere of the giant star, with formation of a filamentary structure.

D. R. BARBER

523.877 : 538.65 : 536.25

On the inhibition of convection by a magnetic field. See Abstr. 6456

526.1

6261. Expressions for the components of the absolute deviation of the vertical on the co-geoid. L. BRAGARD. *C.R. Acad. Sci. [Paris]*, 234, 2157-9 (May 26, 1952) *In French*.

526.7

6262. Comparison of the acceleration due to gravity at the National Physical Laboratory, Teddington, the Bureau International des Poids et Mesures, Sèvres, the Physikalisch-Technische Bundesanstalt, Brunswick, and the Geodetic Institute, Potsdam. A. H. COOK. *Proc. Roy. Soc. A*, 213, 408-24 (July 8, 1952).

The values of gravity at these stations have been compared by means of pendulum observations with Invar invariable pendulums. The observed differences of gravity from the National Physical Laboratory are: B.I.P.M. -256.73 ± 0.49 mgal, P.T.B. $+68.68 \pm 0.49$ mgal, Bad Harzburg -15.68 ± 0.49 mgal. The accuracy of the measurements is not so great as has been achieved once or twice previously with the same apparatus, mainly because the changes in the lengths of the pendulums were greater than usual. These differences have been combined with German pendulum observations and with gravimeter comparisons with the following results: Value of

gravity at N.P.L. on the Potsdam system: 981196.29 ± 0.3 mgal. Differences between sites of absolute determinations of gravity: N.P.L. — B.I.P.M. $+256.45 \pm 0.3$ mgal, N.P.L. — P.T.B. $-68.98 \pm$

0.3 mgal, P.T.B. — Potsdam -8.95 ± 0.4 mgal (at Potsdam = 981274 mgal). The effects of these results on gravity surveys based on Cambridge and on the absolute value of gravity are indicated.

PHYSICS 53

53.081 : 621.3.081
6263. On a simple system of electrotechnical units. M. ESKENAZI. *C.R. Acad. Sci. [Paris]* **234**, 1673–4 (April 21, 1952) *In French*.

The system RELT (resistance, e.m.f., length, time) is proposed to eliminate fractional exponents from the dimensional relations and to eliminate the mass. Relations between the various mechanical, magnetic and electrical quantities and the fundamental units are tabulated.

S. WEINTROUB

53.081.5
6264. The method of dimensions. E. W. H. SELWYN. *Brit. J. Appl. Phys.*, **3**, 209–13 (July, 1952).

The fundamental theory of the method of dimensions, here given in a way which shows why variables appear as products in physical formulae, indicates that any physical quantity which has a character peculiar to itself, and which may be measured by addition of units and of the same character (if necessary by distortion of scale), may be attributed a dimension and used in dimensional arguments. Examples are given.

A.

FUNDAMENTALS 530.1

530.12
6265. Four-dimensional basis of the extended theory of gravitation. P. JORDAN. *Akad. Wiss. Mainz, Abh. Math.-Nat. Kl.* (1950) 319–34. *In German*.

General relativity is generalized by replacing the gravitational constant by a scalar field K . The field equations are derived, by a variational principle, and a spherically symmetric static solution of these equations is given. K must vary slowly if at all if the precession of the perihelion of mercury and the deflection of light by the sun are to be accounted for. The theory is applied to the statistical behaviour of a collection of particles of various masses.

MATHEMATICAL REVIEWS

530.12
6266. Re-examination of the Michelson experiment. A. METZ. *Rev. Opt (Théor. Instrum.)* **31**, 124–6 (March, 1952) *In French*.

In spite of the criticism of several authors, the accepted interpretation is still upheld.

530.12
6267. Supplements to "The unitary theory of fields." M.-A. TONNELAT. *J. Phys. Radium*, **13**, 177–85 (April, 1952) *In French*.

General considerations relevant to the choice of the basic tensor $R_{\mu\nu}$ in the author's unitary field theory [Abstr. 826–8, 5065 (1951)] are discussed. Further restrictions on this tensor are provided by

the requirements of consistency for the field equations and of Maxwellian form for the e.m. equations of the theory.

R. H. DALITZ

530.12 : 531.18
6268. The Fitzgerald contraction. H. E. IVES. *Sci. Proc. Roy. Dublin Soc.*, **26**, 9–26 (No. 1, 1952).

It is argued that the principle of relativity, attributed to Poincaré, does not require the constancy of the velocity of light, but merely that out-and-back measurements should be the same for uniformly moving frames. A complicated system of "complete Lorentz-Poincaré transformations" is set up involving only quantities defined operationally in terms of measurements made with rods and clocks experiencing the Fitzgerald-Lorentz contractions [see also Abstr. 40, 5487 (1950)]. The Ives-Stilwell experiment [*J. Opt. Soc. Amer.* **28**, 215–26 (1938), **31**, 369–74 (1941)] on the rate of a moving atomic clock (high-speed canal rays) is described, and is regarded as direct evidence for time dilatation, and, by inference, for the Fitzgerald contraction.

R. A. NEWING

530.12 : 531.18
6269. The Fitzgerald-Lorentz contraction—some paradoxes and their resolution. W. H. MCCREA. *Sci. Proc. Roy. Dublin Soc.*, **26**, 27–36 (No. 1, 1952).

The paradoxes considered arise from the fact that while the contraction involves no intrinsic physical change in a moving body, a rod or scale could be "trapped" in such a way as to exhibit permanent contraction or expansion. The paradoxes are resolved by analysing the concept of rigidity in relativistic theory and by investigating the physical processes involved in stopping a moving body. A rigid body is defined as a perfectly elastic one through which impulses are transmitted with the speed of light.

R. A. NEWING

530.12 : 531.18
6270. The Fitzgerald-Lorentz contraction phenomenon and theories of the relativity of Galilean frames. G. J. WHITROW. *Sci. Proc. Roy. Dublin Soc.*, **26**, 37–44 (No. 1, 1952).

A general discussion is given of inertial frames in Newtonian and relativistic theories. In Milne's theory [Abstr. 2181 (1950)] the transformations from one Galilean frame to another can be reduced to the Lorentz type if a change is made in the conventional defining time measurement in a Galilean frame.

R. A. NEWING

530.12 : 531.18
6271. Effects of acceleration in the Michelson-Morley experiment. J. L. SYNGE. *Sci. Proc. Roy. Dublin Soc.*, **26**, 45–54 (No. 1, 1952).

Calculations allowing for the accelerated motion

of a rigid body have been applied to interferometer measurements made at the surface of the rotating earth. Results obtained [quoted, no details of the calculation being given] suggest that the positive results obtained by D. C. Miller [*Rev. Mod. Phys.*, **5**, 203 (1933)] and the null results obtained by other observers depend on the degree to which the apparatus was firmly integrated with, or insulated from, the earth. The investigation is based on the following definition of relativistic rigid motion due to G. H. F. Gardner: P and Q are events on the world-lines C and Γ of a chosen point A ("drag-point") and any other point B of a rigid body; L, N_1, N_2, N_3 are a set of normalized orthogonal vectors in space-time, L being tangential to C at P , and $PQ = bL + b_1N_1 + b_2N_2 + b_3N_3$, where the b 's are constants characterizing the point B and such that PQ is a null 4-vector; the world-line C then determines Γ , and hence the motion of B . The rigid motion so defined has 6 degrees of freedom, but depends upon the choice of drag-point. In applications this choice presents an ambiguity.

R. A. NEWING

530.12 : 531.18

6272. Relativistic theory of Sagnac's experiment with the interposition of fixed refracting tubes. A. METZ. *C.R. Acad. Sci. [Paris]* **234**, 597-9 (Feb. 4, 1952) *In French*.

Light is made to travel in opposite directions round a disk rotating with angular velocity ω , the light passing through fixed tubes of water. When the tubes are closed by plates perpendicular to the radii from the centre of the disk, the retardation of one ray relative to the other is found to be $4\omega An^2/c^2$, where A is the area of the path and n is the refractive index of water.

R. A. NEWING

530.12 : 531.18

6273. Relativistic theory of an experiment of Dufour and Prunier. A. METZ. *C.R. Acad. Sci. [Paris]* **234**, 705-7 (Feb. 11, 1952) *In French*.

Calculations are repeated (see preceding abstract) for the case in which the water tubes are closed by plates perpendicular to the length of the tubes; the retardation is found to be $4\omega An/c^2$. This result is in agreement with experimental observations.

R. A. NEWING

530.12 : 531.18

6274. The problems relating to rotation in the theory of relativity. A. METZ. *J. Phys. Radium*, **13**, 224-38 (April, 1952) *In French*.

First-order effects arising from the motion of light relative to a rotating disk have been explained on the ether theory with the aid of *ad hoc* hypotheses, but receive direct explanation in the theory of relativity. A discussion of the experiments of Sagnac, Harress, Dufour and Prunier illustrates the fact that frames of reference may be chosen in various ways in relativistic calculations. See also preceding abstracts.

R. A. NEWING

530.12 : 531.18

6275. On the principle of the constancy of the velocity of light. J. SIVADJIAN. *C.R. Acad. Sci. [Paris]* **234**, 1953-4 (May 12, 1952) *In French*.

Continuation. See Abstr. 4898 (1952).

530.14 : 537.122

6276. On the Liénard-Wiechert potential associated with a world-line. On the retarded potential associated with a continuous current. M. RIESZ. *C.R. Acad. Sci. [Paris]* **234**, 2159-61 (May 26); 2260-1 (June 4, 1952) *In French*.

A geometrical interpretation is given to the potential obtained for a moving point charge by the author's method of analytic continuation [*Acta Math.*, **81**, 1-223 (1949)].

R. A. NEWING

530.145

6277. Principles of quantum mechanics. W. V. HOUSTON. *London, New York, McGraw-Hill* (1951) 288 pp.

This book presents the essentials of non-relativistic quantum mechanics, the purely formal aspects being kept to a minimum, with a view to later applications to physical problems of practical importance. The first part surveys the experimental evidence on wave and particle properties which led to the formulation of quantum theory. Two basic postulates are proposed, from which the remainder of the theory is expounded deductively, its relation to the classical theory being clearly emphasized. The usual eigenvalue problems and approximation methods are discussed, and the Pauli spin theory is adequately presented. The principles developed are then widely illustrated by their application to various physical fields in the remaining four parts of the book. The spectroscopy of one and two electron systems, in particular, is treated with a thoroughness unusual in an introductory text. The theory of collisions is applied to several situations of physical interest. After a brief treatment of quantum statistics, based on the formalism of the density matrix, the properties of a free electron gas are discussed and applied to the theory of electrical conductivity. The motion of electrons in a periodic potential is discussed in some detail and the usual limiting cases are worked out. Finally, the quantum treatment of continuous systems is exemplified by discussion of the electromagnetic field interacting with non-relativistic electrons. A liberal distribution of illuminating and useful problems throughout the text adds greatly to the value of this book.

R. H. DALITZ

530.145

6278. Information aspect of certain relations of "uncertainty." R. VALLÉE. *C.R. Acad. Sci. [Paris]* **233**, 1580-1 (Dec. 19, 1951) *In French*.

An extension of the relation connecting the uncertainty of mean time of a signal with the uncertainty in its mean frequency is presented in informational form.

R. H. DALITZ

530.145

6279. How can the unitary field theory explain emission of radiation, self-energy and Lamb-shift? G. LUDWIG. *Z. Naturforsch.*, **7a**, 248-50 (March-April, 1952) *In German*.

In the unitary field theory [Abstr. 4086 (1951)] the emission of radiation and the Lamb-shift are evoked by the absorber. Since an isolated electron possesses no self-energy, the absorber also evokes the electron self-energy. It is here shown to be probable that, for

the exact validity of the Maxwell equations, this unitary field theory must lead to divergences.

R. H. DALITZ

530.145

6280. Some problems of physical theory. A. GIÃO. *Gaz. Mat. [Lisbon] No. 50, 57-67 (Dec., 1951) In French.*

A collection of five notes discussing, in the light of the author's unitary field theory [Abstr. 5127 (1951)], the following topics: the photon self-mass; the difference in behaviour of mass in gravitational field and of charge in an e.m. field; general properties of the generalized e.m. field; the Schwinger-Tomonaga equation; stellar magnetic fields with periodic variation.

R. H. DALITZ

530.145

6281. On the evaluation of the average over polarization states in processes involving emission or absorption of particles of spin $\hbar$. Application to the electromagnetic, mesic and photomesic Compton effects. G. PETIAU. *J. Phys. Radium, 13, 134-42 (March, 1952) In French.*

Feynman's covariant procedure for summing over polarization states of external particles is demonstrated directly and extended. The results are then used in calculation of various types of "Compton effect."

R. H. DALITZ

530.145

6282. Fundamental particles. H. S. W. MASSEY. *Sci. Progr., 40, 193-212 (April, 1952).—A review.*

530.145

6283. On the stress tensor of the electron. S. BOROWITZ AND W. KOHN. *Phys. Rev., 86, 985-95 (June 15, 1952).*

A suggestion by Schwinger for dealing with problems of gauge invariance has been adapted for treating the radiative corrections to the stress tensor of an electron. The divergencelessness of the stress tensor implies that a certain divergent integral be invariant with respect to translation. Application of this rule gives a zero self-stress and shows that the matrix elements of the symmetric tensor between states of unequal momenta are finite. The canonical tensor, however, remains infinite. The connection with the results of Rohrlich, and Villars, and Pais and Epstein, is discussed.

A.

530.145

6284. On the theory of the luminescent electron. A. N. MATVEEV. Letter in *Zh. Eksper. Teor. Fiz., 21, 1078-9 (No. 9, 1951) In Russian.*

After quoting from other sources an expression for the electromagnetic field of radiation, stated in spherical co-ordinates and developed in Fourier series with n th harmonics expressed in the form of Bessel functions of the first kind J_n , and their derivatives J'_n of the argument proportional to the sine of the latitude, the author derives the expressions for the summation of this series; and from the latter he evaluates the order number of the highest harmonics in the series and the duration of the luminescence.

N. S. JAPOLSKY

530.145

6285. On the representation of the systems of irreducible wave-equations of the theory of particles of arbitrary spin. Application to the calculation of

scattering cross-sections. G. PÉTAU. *C.R. Acad. Sci. [Paris] 234, 1955-7 (May 12, 1952) In French.*

The matrix formalism of the irreducible representations for wave-equations of particles of spin $nh/2$ is obtained from the reducible formalism of de Broglie's method of fusion, by introducing a suitable projection operator. Spur calculations for particles of arbitrary spin are then reduced to calculation of spurs of products of Dirac matrices.

R. H. DALITZ

530.145

6286. The representations of the group of rotations and reflections. Applications of the conservation of parity in quantum mechanics. II. Annihilation of a Dirac particle and antiparticle. L. MICHEL. *C.R. Acad. Sci. [Paris] 234, 2161-3 (May 26, 1952) In French.*

For Pt I, see Abstr. 3306 (1952). Cartan's treatment of the representations of the group of rotations and reflections is summarized. Using this, the final boson states to which the annihilation of a Dirac particle and antiparticle in an S -state cannot lead, are listed.

R. H. DALITZ

530.145

6287. Wave equations for integer spin particles in gravitational fields. O. BRULIN AND S. HJALMARS. *Ark. Fys., 5, 163-74 (Paper 11, 1952).*

Dirac equations for particles of spin 0 and 1 are extended to general relativity. Previous results [Abstr. 1491 (1950)] are used to obtain a representation of the β -matrices in terms of the g_{ij} 's of the gravitational field and the β 's of special relativity. The corresponding Klein-Gordon and Proca equations are derived.

R. A. NEWING

530.145

6288. On the law of conservation of heavy particles. E. P. WIGNER. *Proc. Nat. Acad. Sci. [Wash.] 38, 449-51 (May, 1952).*

"Heavy particle" conservation may be regarded as a conservation of "neutronic" charge, or, if a closer analogy with electric charge is correct, as a conservation of "mesic" charge. This latter view leads to predictions concerning heavy particle scattering.

R. H. DALITZ

530.145

6289. Pseudoscalar coupling in pseudoscalar meson theory. G. WENTZEL. Letter in *Phys. Rev., 86, 802 (June 1, 1952).*

Foldy's transformation [Abstr. 79 (1952)] of psc. meson theory with psc. coupling leads to a psv. coupling term, together with coupling terms non-linear in the meson field. Of these, a typical term has the form of the coupling of meson pair theory, already studied in the strong coupling approximation [Abstr. 3326 (1951)]. However, the isotopic-spin-dependent character of meson-proton scattering could not result from these non-linear couplings alone, but could arise only if the psv. coupling term were effective.

R. H. DALITZ

530.145

6290. The symmetrical pseudoscalar meson theory of nuclear forces. M. M. LEVY. Letter in *Phys. Rev., 86, 806 (June 1, 1952).*

Using a charge-symmetric nucleon-nucleon potential which, for $r > r_0$, is the static potential resulting from exchange of one or two psc. mesons (with psc.

coupling) between the nucleons, and which is strongly repulsive for $r < r_0$ (as relativistic calculations suggest), low-energy data may be accounted by a reasonable choice of two parameters r_0 and $f^2/4\pi$. R. H. DALITZ

530.145

91. Nonlinear meson theory of nuclear forces. Quantization of the neutral scalar case with non-linear coupling. L. I. SCHIFF. *Phys. Rev.*, **86**, 856 (June 15, 1952).

For Pt II, see Abstr. 9280 (1951). The problem of a number of infinitely massive point nucleons interacting according to the neutral scalar meson theory with a non-linear coupling of the power-law type was considered classically in Pt II. It was found there that the interaction is the same as with the usual linear coupling. This system is now quantized, and it is shown that the same conclusion is valid in quantum theory. The case of exponential coupling, considered by Glauber, lies outside the scope of the present investigation. A.

530.145

92. On the methods of Feynman. G. RIDEAU. *R. Acad. Sci. [Paris]* **234**, 1852-5 (May 5, 1952) in French.

The author's formalism [Abstr. 6039-40 (1951)] for calculation of transition amplitudes is shown to lead to the techniques introduced by Feynman. A further form is then obtained for the scattering equation for the wave-function. R. H. DALITZ

530.145

93. The neutron-electron interaction. S. BOROMIRZ. Letter in *Phys. Rev.*, **86**, 567 (May 15, 1952).

There are two effects, which arise from the interaction of the field of the electron respectively with the neutron polarization and convection currents. It was not clear whether previous calculations had taken into account both of them. Their ratio is independent of the coupling constant. This ratio was calculated with a symmetric pseudoscalar theory and found to be 1/23. Thus the two interactions, expressed as uniform potentials over a distance equal to the classical radius of the electron, are 3900 (previously determined) and 1208 eV; and the total interaction 5108. These results are in fair agreement with Hughes' experimental value 6200 ± 700 . L. PINCHERLE

530.145

94. Higher approximations to the potential between nucleons. G. EDER. *Acta Phys. Austriaca*, **2**, 404-13 (No. 3, 1952) in German.

The potential between nucleons interacting through vector mesons is worked out in 2nd and 4th order using symmetrical, charged and neutral theories and the Feynman-Dyson techniques. The distance dependence of the potential is such that the question whether a π -meson is a bound state of a nucleon and an antinucleon remains an open one. W. J. SWIATECKI

530.145

95. A note on the absorber theory of radiation. P. HAVAS. *Phys. Rev.*, **86**, 974-5 (June 15, 1952).

The Wheeler-Feynman theory, starting with fields symmetric in time, obtained the Lorentz-Dirac equations of motion, which use retarded fields only, together with a condition on the total field of all particles in the universe. It is shown that if the field

acting on a particle produced by all other particles is static but not zero, no motion of the system satisfying this condition exists. Some implications of this result for the physical interpretation of the Wheeler-Feynman theory are discussed. A.

530.145

6296. On the notion of the Fermi scattering length. T. SEXL. *Acta Phys. Austriaca*, **5**, 336-40 (No. 3, 1952) in German.

This is derived from the early nucleon-nucleus scattering theory of Guth and Sexl. W. J. SWIATECKI

530.145

6297. The exact mathematical theory of multiple scattering of particles in an infinite medium. C. C. GROSJEAN. *Verh. K. Vlaamse Acad. Wetensch. Belg.*, **13**, 5-156 (No. 36, 1951).

Continuation of earlier work [Abstr. 4769, 6477 (1951)], the exact general equations of multiple scattering in an infinite medium are set up, firstly for isotropic scattering, the solutions being obtained in integral form. Extension is then made to the non-isotropic case, time and energy dependence in the scattering being included. The theory is then applied to thermal diffusion in an infinite medium, for point and plane δ -function sources, and for an arbitrary distribution of isotropic sources. J. HUGHES

530.145

6298. Radiative corrections to Compton scattering and Bremsstrahlung. A. N. MITRA. Letter in *Nature [Lond.]* **169**, 1009-10 (June 14, 1952).

The e^2 -radiative correction to the differential cross-sections for the Compton effect and for Bremsstrahlung by a Coulomb field are given, and it is explicitly verified that its infrared catastrophe is cancelled by a corresponding term in the double Compton effect, and double Bremsstrahlung effect, respectively.

R. H. DALITZ

530.145

6299. π -mesons and quantized field theory. G. LÜDERS, R. OEHRME AND W. E. THIRRING. *Z. Naturforsch.*, **7a**, 213-34 (March-April, 1952) in German.

The π -mesons are known to be pseudoscalar. For psc. bosons, the renormalization programme can be carried through only if the coupling is psc. This paper surveys the experimental evidence on production, scattering and decay of π -mesons, asking whether it is compatible with this theoretical requirement. No final conclusion is possible since only weak coupling calculations have been made, whilst the evidence shows that, for a psc. theory, the coupling constant must be large.

R. H. DALITZ

530.145

6300. On the determination of eigenvalues and eigenphase for the Yukawa potential. K.-G. FOGEL. *Ark. Fys.*, **4**, 573-9 (Paper 42, 1952).

The Schrödinger equation is solved by an expansion in powers of the potential. The energy eigenvalues appear as the zeros of a certain real solution, from which the Yukawa potential leading to zero binding energy is here calculated, to the 5th approximation. The scattering phase is calculated to second approximation from a complex solution, and the results for the Yukawa potential are compared with previous calculations. R. H. DALITZ

530.145.6
6301. On the open character of wave mechanics. P. DESTOUCHES-FÉVRIER. *J. Phys. Radium*, 13, 210–15 (April, 1952) In French.

The notion of "completeness" of a theory is discussed. Wave mechanics is shown to be an open or "incomplete" theory, in that it is possible to suppose that there exist further co-ordinates, ignored in the present theory. However, the "more complete" theory can never be a deterministic theory (i.e. a "complete" or closed theory). Various past attempts to construct a deterministic theory of microphysics are examined.

R. H. DALITZ

530.162
6302. Convexity and information. R. FÉRON. *C.R. Acad. Sci. [Paris]* 234, 1840–1 (May 5, 1952) In French.

A study, in very general terms, of functions suitable for use in defining the "uncertainty" of a random variable (reduction of "uncertainty" = gain of "information").

N. L. JOHNSON

GENERAL MECHANICS . MECHANICS OF SOLIDS 531

531.224.4
6303. Instability of thin-walled cylinders subjected to internal pressure. J. A. HARINGX. *Philips Res. Rep.*, 7, 112–18 (April, 1952).

It is shown that under certain conditions a thin-walled cylinder may buckle when subjected to internal pressure. The critical value of this pressure can easily be calculated by means of Euler's well-known formula. Most of the formulae for pressure-loaded cylinders given in current text-books, however, fail to predict this behaviour and should therefore be applied with caution in the case of great lengths and/or high pressures.

A.

531.258
6304. On the concentration of stress in the neighbourhood of a circular hole in a semi-infinite plate. B. KARUNES. *Indian J. Phys.*, 25, 599–606 (Dec., 1951).

Stress functions giving the stress distributions in the neighbourhood of a circular hole in a semi-infinite plate under (1) a uniform tension perpendicular to the straight edge and (2) a uniform shear in the plane of the plate has been obtained in bi-polar coordinates. The stresses over the circular boundary are calculated and their distributions are discussed.

A.

531.383
6305. The deviations of the artificial horizon of Fleuriais. G. HEINRICH. *Öst. Ingen.-Arch.*, 6, 113–25 (No. 2, 1952) In German.

See Abstr. 7573 (1951). First, an aerodynamic disturbing effect is considered which is caused by the air flow in the gyroscope box. This effect disappears when the gyroscope rotates in the vacuum. When the time mean value of the measured height is determined for a bearing by stars during normal building-up by means of an integrator, an optimum integration time exists for which the measuring fault will be a minimum; this time is calculated. Finally, the

deviations caused by the rolling of the vessel are determined, and the optimum position of the observation plane with regard to the roll axis of the vessel is computed.

A.

MECHANICAL MEASUREMENTS 531.7

531.715.1 : 535.543
6306. Birefringent stepgauge. K. B. BLODGETT. *Science*, 115, 515–16 (May 9, 1952).

A new type of stepgauge has been made which makes use of the principle that a birefringent material, placed between two properly oriented polarizing films, transmits light which, in general, exhibits interference colours. The birefringent stepgauge consists of a set of small pieces of a birefringent plastic, cut and stacked together so as to form a flight of steps. Each step differs from the next by a constant thickness, which is usually the thickness of one layer of plastic.

S. TOLANSKY

531.715.2 : 535.822
6307. Measurement of the thickness of transparent films with the light-profile microscope. H. RAHBEK AND M. OMAR. Letter in *Nature [Lond.]* 169, 1008–9 (June 14, 1952).

The light-profile technique [see Abstr. 4284 (1952)] is adapted to the determination of the optical thickness of transparent films. Under the profile microscope a double image is seen, the light profile being reflected from the two faces of the film, separation being determined by the thickness. The method is applied to the measurement of a sheet of mica and the value so obtained proved to be correct by interferometry calibration. Thin films of collodion, Canada balsam and liquids have been measured.

S. TOLANSKY

531.715.2 : 535.822
6308. Measurements of amplitudes of micro-oscillations using a microscope light-cut technique. S. TOLANSKY AND H. RAHBEK. Letter in *Nature [Lond.]* 169, 1060 (June 21, 1952).

The high resolution light-profile technique formerly described [see Abstr. 4284 (1952)] is applied to the measurement of the amplitudes of magnetostriction oscillators. The microscopic image of a line is broadened by the oscillating surface and from the width of the image the amplitude can be directly measured. The technique is suitable for amplitudes exceeding 1 micron and is applied to a vibrating rod of Monel metal.

S. TOLANSKY

531.768
6309. The reciprocity calibration by piezoelectric accelerometers. M. HARRISON, A. O. SYKES AND P. G. MARCOTTE. *J. Acoust. Soc. Amer.*, 24, 384–9 (July, 1952).

Two piezoelectric accelerometers were calibrated by an absolute reciprocity technique in the frequency range from 100 c/s to 10 kc/s. A theoretical and experimental evaluation of the technique is given.

A.

531.785 : 621.838.3
6310. A magnetic fluid dynamometer. D. W. BREDE. *Trans Amer. Inst. Elect. Engrs*, 70, 1652–5 (Pt II, 1951). For abstract see Abstr. 2445 (1952).

531.79 : 621.317.79

6311. An electronic device for measuring small transient displacements. J. J. TROTT. *J. Sci. Instrum.*, **29**, 212-14 (July, 1952).

Displacements of magnitude down to $10\text{ }\mu\text{in}$ may be measured, the apparatus being suitable for use whenever it is possible for part of the equipment to be mounted on a stable support and a small, lightweight steel plate to be attached to the moving part. It was devised initially for measuring the relative and absolute movements of concrete road slabs under the wheel loads of vehicles. The device is based upon the variation of output of a h.f. oscillator caused by the movement of a metal disk near its tuning coil, and the output is linear over the range up to $0\cdot10\text{ in}$. The equipment is used with a persistent c.r.t. for visual estimation of displacements, and with cathode-ray recording gear when permanent photographic records of the displacements are needed. A.

MECHANICS OF FLUIDS 532

532.13

6312. Temperature dependence of the viscosity of associated liquids. T. A. LITOVITZ. *J. Chem. Phys.*, **20**, 1088-9 (July, 1952).

By assuming that the activation energy for flow in associated liquids is proportional to the inverse square of the absolute temperature, an empirical expression for the viscosity is obtained, which fits the data well. An empirical expression for the activation energy of mixtures of associated liquids is also proposed. A.

532.13, 533.16

6313. The second coefficient of viscosity of liquids and gases. S. M. KARIM AND L. ROSENHEAD. *Rev. Mod. Phys.*, **24**, 108-17 (April, 1952).

The classical theory of the dynamics of viscous fluids is based on the assumption that there is only one fundamental coefficient of viscosity, μ , the coefficient of shear viscosity. The other quantity, μ' , the second coefficient of viscosity, is assumed to be equal to $-2\mu/3$ in order that $\kappa = (2\mu + 3\mu')/3$, the coefficient of bulk viscosity, should be zero. In making this assumption classical hydrodynamics parts company from classical elasticity, in which two fundamental quantities, the Lamé constants λ and μ , are introduced. The above assumption seems to have some basis in theory only in the case of ideal monatomic gases; it has, however, been carried over implicitly to both liquids and gases of all degrees of complexity. One might therefore expect some differences to exist between theoretical predictions and experimental results due to this oversimplification. The present review has been undertaken with a view to exploring the existence and the magnitude of any such differences. Up to the present, discrepancies have been noticed in the field of investigation which deals with the transmission of sound energy through liquid and gases. As far as liquids are concerned no work has been done on the absorption of energy associated with vibrations in the sonic range (20 to 20 000 vibrations per second). In the ultrasonic range experimental

values of absorption differ from the theoretical ones by factors ranging from 3 to 1000. In gases, both in the sonic and supersonic ranges, the values differ by a factor whose magnitude lies in the range of 4 to 100. Most of the work which has been done in this field has been concerned with the passage through liquids of sound energy in the ultrasonic range of frequencies. Here it is clear that the value of μ'/μ deduced from experiment is in good agreement with the value of the ratio deduced from information on excess absorption of energy. The viscosity ratio is never negative; its value ranges from about 1 to about 120 in the cases so far investigated. A.

532.137

6314. Two viscometers for rapid measurements at definite shearing stresses. R. S. HIGGINBOTHAM AND J. J. BENBOW. *J. Sci. Instrum.*, **29**, 221-4 (July, 1952).

Two modifications of the cone and plate viscometer [Abstr. 5553 (1950)] are described. The first, for measurements at low shearing stresses (10 to 100 dyn/cm^2), employs a phosphor-bronze strip to apply torque to the cone. The second, a direct reading instrument for measurements at a relatively high stress (4500 dyn/cm^2), uses a small d.c. motor running at constant torque to drive the cone. The range of the first instrument is 1 to 100 poises at 10 dyn/cm^2 , and 10 to 1000 poises at 100 dyn/cm^2 , that of the second is $0\cdot5$ to 30 poises. Their accuracy varies according to the viscosity and anomaly of the fluid under examination, but the average is about $\pm 5\%$, which is quite adequate for many purposes. The examination of a sample with either instrument, including filling and cleaning, can be completed within two minutes. A.

532.5

6315. On some basic problems in hydrodynamics. R. VON MISES. *Öst. Ingen.-Arch.*, **6**, 77-85 (No. 2, 1952) In German.

Studies the possible discontinuities appearing in the solutions of the hydrodynamic equations whereby the usual adiabatic condition is replaced by a widely more general relation. The principal results are as follows: in the case of a fluid without viscosity and heat conduction the theory of characteristics leads to two different types of discontinuities, (a) those which are found in the jet problem of Helmholtz, in the wing theory of Lanchester-Prandtl, and in the so-called contact discontinuities of compressible fluids; (b) those discontinuities which are well known from the theory of potential flow at supersonic velocities; in the presence of viscosity and/or heat conduction the theory of characteristics admits only discontinuities of type (a); in this case, however, one can find asymptotic integrals (in a similar way as in the theory of boundary layers) for Reynolds number and/or Prandtl number tending to infinity; these asymptotic integrals represent the flow patterns that are usually called shocks. A.

532.51 : 591.17

6316. Some hydrodynamical aspects of the swimming of snakes and eels. G. E. GADD. *Phil. Mag.*, **43**, 663-70 (June, 1952).

A drastically idealized case is considered for which a fairly simple mathematical solution can be found. Propulsive efficiency is treated, and the mathematical

solution for the idealized case presented. The relevance of this solution to the swimming of animals such as snakes and eels is then discussed. A.

532.517

6317. The stability of plane Poiseuille flow. L. H. THOMAS. Letter in *Phys. Rev.*, **86**, 812 (June 1, 1952).

For small disturbances to the plane-parallel, steady flow of incompressible fluid between parallel planes, the change in the stream function can be analysed into components of the form $\exp(i\alpha x)\exp(ict)\phi(y)$, where $\phi(y)$ satisfies the Orr-Sommerfeld equation, $\phi'''' - 2\alpha^2\phi'' + \alpha^4\phi + i\alpha R[(1 - c - y^2)(\phi' - \alpha^2\phi) + 2\phi] = 0$ and R is the Reynolds number of the flow. Work by Lin [Abstr. 1241 (1946)], showing that for $R > \text{about } 5300$, the flow becomes unstable, has been adversely criticized by Pekeris [Abstr. 2735 (1948)]. Adopting a suggestion made by von Neumann, Lin and Pekeris that the disputed question of the incidence of instability should be settled by numerical integration of the Orr-Sommerfeld equation, it has now been shown, by using an electronic calculator, which reduced 100 years manual computing to 150 hours' work, that the critical Reynolds number for plane Poiseuille flow is $R = 5780$ for $\alpha = 1.02$, confirming Lin's result referred to above, and a further result obtained by him, viz., that for a given value of α , the flow is unstable only for a finite range of Reynolds numbers. J. S. G. THOMAS

532.517.4 : 533.6.013.22

6318. The effect of homogeneous turbulence on material lines and surfaces. G. K. BATCHELOR. *Proc. Roy. Soc. A*, **213**, 349-66 (July 8, 1952).

A material line consisting always of the same particles of fluid is lengthened by the convective action of turbulent motion, at a rate which is shown to be exponential at a sufficient time after the initial choice of the line. The area of material surface elements also increases exponentially, although with a different exponential coefficient. It is then a consequence of conservation of mass of the fluid that the normal distance between two neighbouring parallel material surfaces decreases at an exponential rate which is simply related to the rate at which material lines lengthen. These kinematical results are relevant to the convective action of the turbulence on the distribution of two kinds of local property of the fluid, viz. quantities, represented by θ , of which the total amount in a material volume of the fluid remains constant (e.g. mass density of a foreign substance), and quantities, represented by F , of which the total flux across a material surface remains constant (e.g. vorticity). F is proportional, at all times, to the vector representing a material line element, and $G = \nabla\theta$ is proportional to the vector representing a material surface element, and hence they both increase exponentially in time. The last two sections of the paper are concerned with the combined effect on F and G of convection and molecular diffusion, and a condition for the effect of the convection to be dominant is obtained. In the case of F , convection is found to be dominant if the appropriate molecular diffusivity is small compared with the kinematic viscosity of the fluid, and $\bar{F}^2$ will then increase indefinitely, unless some additional effect comes into play (as it does in the case of magnetic field strength).

In the case of G , convection will be dominant if the initial distribution of G has a large enough length scale; the effect of the convection is to decrease this length scale so that ultimately the two effects reach an equilibrium. The length scale of the ultimate distribution of G , as obtained herein, is different from that put forward recently by Obukhoff. A.

532.527

6319. Energy transference between wave numbers in isotropic turbulence. H. SATO. Letter in *J. Appl. Phys.*, **23**, 698-9 (June, 1952).

Energy transference, in isotropic turbulence, between different ranges of wave numbers has been studied by Stewart by measuring the triple correlation of velocity fluctuations [Abstr. 1657 (1951)]. Now Sato has studied the decay of spectral components of turbulence by means of a hot wire traversing the flow longitudinally. Decay of components is more marked with increase of wave number. Wave numbers of no transference and of maximum flow decrease with decay of turbulence [Abstr. 3370 (1952)]. J. S. G. THOMAS

532.57

6320. Measurement of speed of rotation, velocity and flow by means of unipolar induction. H. HINTEREGGER. *Öst. Ingen.-Arch.*, **6**, 93-104 (No. 2, 1952) In German.

Unipolar induction is explained as stationary induction by movement. A systematic treatment of the basic effects of unipolar induction is given. Movements which are variable with time are discussed. The measuring voltage as influenced by eddy currents is determined. Benfield's tachometer is critically reviewed, and more efficient devices (which are found by applying systematically the principle of stationary induction) are described. Possibilities are shown for developing Kolin's "electromagnetic flowmeter" so that it will become a measuring device for hydrodynamical research. A.

CAPILLARITY 532.6

532.61.08

6321. Performance of sessile drop in surface tension measurements. N. R. TAWDE AND K. G. PARVATIKAR. *Indian J. Phys.*, **25**, 473-80 (Oct., 1951).

In an attempt to improve the sessile drop method for accurate surface tension measurements, Taylor and Alexander have fitted up an empirical relation by which the values of h/r are related to a^2/r^2 in a tabular form [Abstr. 1980 (1944)]. In this paper a similar table has been drawn up, but from fundamental considerations, using Bashforth and Adams's tables. A comparative fresh experimental study of both is also presented. A.

532.65 : 532.51

6322. A study of circulation patterns within liquid drops moving through a liquid. K. E. SPELLS. *Proc. Phys. Soc. [Lond.] B*, **65**, 541-6 (July, 1952).

The technique used to reveal the circulation patterns was developed by Hagerty [Abstr. 4739 (1950)] and depends on the striae which appear in glycerine and glycerine-water mixtures when sheared. Instantaneous flash photographs were taken of circulation

patterns in drops of glycerine falling slowly (about 1 cm/sec) in castor oil, and in drops of various glycerine-water mixtures falling at about 10 cm/sec in heavy white oil (viscosity 0.37 poise at 15°C). In the former case the drops were spherical and the circulation pattern agreed reasonably well with that predicted theoretically by Hadamard; in the latter case the drops were no longer spherical and the centre of circulation was displaced below the equatorial plane. A.

532.65 : 537.22

6323. The electrification of liquid drops. E. W. B. MILL AND G. F. ALFREY. *Proc. Phys. Soc. [Lond.] B*, **65**, 546-51 (July, 1952).

Charges on drops breaking up in electric fields were investigated and it was found they could all be explained by the ordinary laws of electrostatic induction, with allowance for contact potential differences. Electrification due to splashing was also studied and again the effects could be explained by contact potentials alone, so that theories of double layers put forward to explain previous experiments are unnecessary. A warning is given of the necessity of making due allowance for possible electrification by splashing in interpreting experimental results, and a critical examination of an experiment of Zeleny is reported. A few experiments of splashing water drops on ice gave results which may have a bearing on the production of electricity in thunderstorms. A.

532.74 : 537.531 : 535.42

6328. The diffraction of X-rays by liquid alloys of sodium and potassium. N. S. GINGRICH AND R. E. HENDERSON. *J. Chem. Phys.*, **20**, 1117-20 (July, 1952).

Monochromatic X-ray diffraction patterns were taken of liquid alloys of Na and K of seven different compositions at 115°C. Contrary to previous results, the present work does not show in a plot of position of main peak *v.* composition an inflection which had been taken as evidence for the existence of Na₂K molecules in the liquid. Fourier analyses made for five of the alloys gave distribution curves which prove that there are no compact molecules in these liquid alloys, though they do not rule out the possibility that there may be weakly associated groups of atoms. A.

MECHANICS OF GASES 533

MOLECULAR THEORY OF LIQUIDS 532.7

532.7

6324. Radial distribution functions and the equation of state of fluids composed of molecules interacting according to the Lennard-Jones potential. J. G. KIRKWOOD, V. A. LEWINSON AND B. J. ALDER. *J. Chem. Phys.*, **20**, 929-38 (June, 1952).

The integral equation for the radial distribution function of a fluid composed of spherical molecules interacting according to a modified Lennard-Jones potential was integrated in the Kirkwood approximation and in the Born-Green approximation over a wide range of temperature and density. The distribution functions so obtained were used to calculate the equation of state and the thermodynamic functions of the fluid. The calculated thermodynamic functions are compared with the experimental values for liquid A.

532.7 : 530.162

6325. The Gaussian approximation for the probability density of a molecule in a cell. G. CARERI. *J. Chem. Phys.*, **20**, 1114-16 (July, 1952).

Kirkwood's integral equation of the free volume theory of liquids has been used to test the Gaussian approximation for the probability density *F(r)* of a molecule in a cell. The approximation has been found to be good, even up to the critical point. A.

532.73

6326. The modern theory of solutions. R. P. BELL. *Sci. Progr.*, **39**, 593-607 (Oct., 1951). A review.

6329. Generalization of a problem of Kolmogorov, Petrovskii and Piskov [concerning the autocatalytic increase in the number of particles taking part in the process of diffusion]. N. S. AKULOV. *Dokl. Akad. Nauk SSSR*, **80**, 573-6 (No. 4, 1951) In Russian.

533.15

6330. Diffusion in the system C¹⁴O₂-CO₂ to 1000 atmospheres pressure. K. D. TIMMERHAUS AND H. G. DRICKAMER. *J. Chem. Phys.*, **20**, 981-4 (June, 1952).

Diffusion coefficients are presented for the system C¹⁴O₂-CO₂ in the pressure range 100-1000 atmospheres, at temperatures 0°-25°-50°C. In the lower part of the range the results are consistent with those of Robb and show little temperature coefficient for diffusion at constant density. At higher densities the temperature coefficient increases rapidly. The dense gas theory of Enskog is totally inapplicable, but the results are correlated in the form $D = D_0 \exp(-E/RT)$. The activation energy (*E*) at constant density and *D*₀ are given as a function of density in a form useful for extrapolation. A.

533.2

6331. Elastic fluids. E. G. RICHARDSON. *Acta Phys. Austriaca*, **5**, 390-7 (No. 3, 1952) In German.

A lecture describing the properties and behaviour of these liquids in a coaxial cylinder viscometer and when flowing out of a circular pipe. J. E. CAFFYN

533.21

6332. Procedure for the determination of compressibility of gases under high pressure. I. R. KRICHEVSKIĬ AND D. S. TSIKLIS. *Dokl. Akad. Nauk SSSR*, **78**, 1169-72 (No. 6, 1951) In Russian.

533.5 : 621-52 : 621.317.79

6333. An automatically-controlled Knudsen-type vacuum gauge. C. N. W. LITTING AND W. K. TAYLOR. *Proc. Instn. Elect. Engrs, Pt IV*, **99**, 241-9 (July, 1952) [Monogr. No. 36].

Pressures from 10^{-8} mm to 10 mm Hg are indicated on a moving-coil instrument used in conjunction with a range-change switch. The disadvantages of delicacy and slowness of response are eliminated and several additional advantages provided. The new gauge operates on the principle of balancing the pressure-dependent radiometric force by an electrostatic force, the pressure then being calculated from a measured potential difference and the dimensions of the gauge. The principal units of the instrument control system are described in detail and an overall analysis is developed. A.

533.6.011.5

6334. Experiments on two-dimensional supersonic flow in corners and over concave surfaces. N. H. JOHANNESEN. *Phil. Mag.*, **43**, 568-80 (May, 1952).

Two simple cases of two-dimensional supersonic flow were investigated by schlieren photography, viz. the flow in two consecutive corners and the flow over a circular-arc profile concave to the stream. The flows were photographed for smooth and rough surfaces of the models, i.e. with laminar and turbulent boundary layers, and the observed flow patterns are compared with those predicted by inviscid theory. The flow with a turbulent boundary layer was in good agreement with inviscid theory outside the boundary layer, whereas the laminar boundary layer separated and a shock wave originated at the point of separation. In both cases the agreement was good at points far from the surface. A discussion is given of the flow at the point of intersection of three shock waves, and of a shock wave and a centred compression. For the latter case photographs show a weak shock wave in the direction of the downstream Mach line at the point of intersection. A.

533.6.013.22 : 532.517.4

The effect of homogeneous turbulences on material lines and surfaces. See Abstr. 6318

533.6.08

6335. Contributions to the method of hot-wire [anemometry]. G. DÄTWYLER. *C.R. Acad. Sci. [Paris]* **234**, 1848-50 (May 5, 1952) In French.

The following matters are briefly discussed theoretically: (1) the calibration of hot-wire anemometers, applied to the measurement of turbulent flow, in terms of the heating current, in place of calibration in terms of the velocity of flow, using King's formula for the heating energy in terms of the velocity of flow; (2) the application of solutions of Tricomi's equation to (a) jet flow and (b) past a profile; (3) correction to the value of the heating current owing to a difference between the temperature of still air and air in motion.

J. S. G. THOMAS

533.6.08 : 551.508.5

6336. The design and development of three new types of gust anemometer. H. H. ROSENBROCK. *Rep. Brit. Elect. Res. Ass., Ref. C/T106*, 37 pp. (1951).

All have a response time less than 0.1 sec, and are intended for use in a research into wind behaviour. They use small perforated spheres of Al as the detecting

element, and mechano-electronic transducers to give an electrical indication. The three types measure respectively: (a) The horizontal component of the wind velocity. (b) The horizontal component at right angles to the mean wind direction. (c) The vertical component of the wind velocity. Details are given of the supply and control circuits and the recorders used with the anemometers. A circuit is described which allows the peak gust velocity to be continuously recorded by an unresponsive recorder. A.

533.6.08 : 551.508.5

6337. The Pitot cylinder as a static pressure probe in turbulent flow. A. H. GLASER. *J. Sci. Instrum.*, **29**, 219-21 (July, 1952).

The probe described will give good accuracy in a fixed position in a natural wind of rapidly varying direction and speed. It is in the form of a long cylinder with two radial holes separated by a critical angular distance. The static pressure is obtained as the average of the pressure on the two holes, the average being formed by equal capillary resistances between each hole and the common tube to the manometer. A.

MOLECULAR THEORY OF GASES 533.7

533.7 : 536.23

Conduction of heat in a monatomic gas. See Abstr. 6445

533.7 : 541.183

6338. Is hydrazine associated in the gaseous phase? (Vapour density and adsorption measurements). G. BRIEGLEB, H. SCHOLZE AND W. STROHMEIER. *Z. phys. Chem.*, **199**, 15-21 (Jan., 1952) In German.

Measurements of vapour densities of hydrazine, methylated hydrazine and ethylene diamine in a temperature range from 30° to 60° are described. It is concluded that these compounds are not associated in the gaseous phase. The observed decrease in the number of molecules at higher pressure is caused by adsorption. Adsorption isotherms on glass are measured: hydrazine is as much adsorbed as water. Hydrazine-water mixtures show exceedingly strong adsorption effects. A. J. TAYLOR

533.75

6339. The second virial coefficient of a 6-9 gas at high temperatures. L. F. EPSTEIN AND C. J. HIBBERT. *Letter in J. Chem. Phys.*, **20**, 752-3 (April, 1952).

The expression [see Abstr. 979 (1952)] for the second virial coefficient of a gas which satisfies a Lennard-Jones 6-9 potential is rewritten as the summation of an infinite series of terms involving $\theta = \epsilon/kT$. This has been summed for several values of θ in the range $0 \leq \theta \leq 2$. The numerical results are tabulated and are adequate for at least all the permanent gases. Two curves of these results and the previously derived results for a 6-12 potential [Abstr. 1564 (1950)], plotted against θ for $0 \leq \theta \leq 0.4$, are shown to be very similar in shape so that it is nearly impossible to distinguish between the different types of gases from second virial coefficient measurements alone over normal temperature ranges.

W. H. DENTON

VIBRATIONS . ACOUSTICS 534

534.21

40. On the question of the impulse of a sound wave. A. SCHÖCH. *Z. Naturforsch.*, 7a, 273-9 (March-April, 1952) In German.

The first section deals with the wave equation and its solution for a uni-dimensional progressive sound wave. Then follow sections dealing with the radiation pressure and impulse of a progressive wave, radiation pressure and energy-density, and the case of the unrestricted 3-dimensional wave. It is concluded that in the case of a progressive sound wave a "wave-pocket" possesses a very definite impulse, whereas in the periodic stationary wave the impulse is on the average zero.

A. B. WOOD

534.21 : 771.535

341. A new photographic method of detecting ultrasonic radiation. L. PÉTERMANN. Letter in *Acoust. Soc. Amer.*, 24, 416-17 (July, 1952).

In earlier papers [Abstr. 6349 (1952), 7633 (1951)] an ultrasonic field was studied by the effect of ultrasonic radiation on phosphorescent material. In Bennett's technique, the required exposure was an hour with a mean acoustic power of 1-5 watts/cm². The method now described requires exposures of only 1 min and a power of 0.1-0.5 watts/cm². The ultrasonic beam is absorbed in the dark by a Ca-SrS phosphorescent plate, 1 mm thick, the light excitation of which has been provided by a Hg vapour lamp. At each point, the temperature of the phosphorescent material increases proportionally to the ultrasonic intensity and decay of phosphorescence occurs more rapidly at the higher temperatures. After the exposure, the plate has dark areas corresponding with high radiation intensity and is then printed in contact with a panchromatic plate using 20 sec exposure. A method of measuring ultrasonic intensity by this technique is being studied.

A. C. WHIFFIN

534.22/23

6342. Propagation of ultrasonic waves in vapours near the critical point. H. D. PARBROOK AND E. G. RICHARDSON. *Proc. Phys. Soc. [Lond.] B*, 65, 437-44 (June, 1952).

An experimental study is made of the velocity and absorption of ultrasonic waves in carbon dioxide and ethylene at frequencies between $\frac{1}{2}$ and 2 Mc/s and at pressures up to 100 atmospheres in a variable-path acoustic interferometer. At pressures above 10 atmospheres the results are independent of frequency (in this range) in the gaseous phase. The velocity and absorption coefficient reach a minimum near the condensation point, but especially at the critical point itself have high and indeterminate values when the change of phase takes place. The ultrasonic viscosities calculated from these measurements are of the order of 1000 times those derived from transpiration or low-frequency oscillation experiments.

A.

534.22

6343. The velocity of sound in porous media. H. LABHART. *Z. angew. Math. Phys.*, 3, 205-11 (No. 3, 1952) In German.

Measurements made show the very close relation between sound velocity and pore volume in a Ni-Zn

ferrite of fixed composition. Schematizing the complicated state of stress and strain in a porous medium in a rough manner, a theoretical expression for the sound velocity is derived that fits the experimental curve astonishingly well.

A.

534.222.2 : 531.259.223

6344. Transient compression waves from spherical and cylindrical cavities. H. L. SELBERG. *Ark. Fys.*, 5, 97-108 (Paper No. 7, 1952).

The propagation of a shock stress in an isotropic elastic solid having at its centre (a) a hollow sphere, (b) an infinitely long cylindrical cavity, is investigated theoretically. It is assumed that a pressure $P(t)$ is applied uniformly over the whole internal surface of the cavity and that a stress-wave is propagated in the solid at a constant (sonic) velocity. Two separate cases are examined: (i) when $P(t)$ is suddenly applied and remains const.; (ii) when sudden application of $P(t)$ is followed by an exponential decay. It is found that considerable tensional stresses rapidly arise tangential to the cavity surface; it is suggested that these are responsible for the appearance of a radial system of cracks around the bore-hole in rock-blasting. Both radial and tangential stresses decrease with distance (r) from the cavity centre: for a spherical cavity the stresses decrease as r^{-1} (on static loading these stresses decrease as r^{-3}) and for a cylindrical cavity as $r^{-\frac{1}{2}}$ (statically, as r^{-2}). Some numerical solutions, for Poisson's ratio = 0.25, are presented graphically.

A. SCHOFIELD

534.23 : 532.13

6345. Measurement of dynamic shear viscosity and stiffness of viscous liquids by means of traveling torsional waves. H. J. MCSKIMIN. *J. Acoust. Soc. Amer.*, 24, 355-65 (July, 1952).

A short periodically repeated train of torsional waves is transmitted along a glass or metal cylindrical rod. After reflection from the free end, these waves are sent back to the quartz crystal which serves as both transmitter and receiver. The phase shift and added attenuation caused by immersing the rod in the test liquid are measured by means of a special balancing arrangement, and yield a calculation of the impedance presented to the rod surface. From an analysis of wave propagation both in the rod and in the liquid, one can calculate the characteristic shear impedance of the liquid, and the dynamic viscosity and stiffness. Data for polyisobutylene liquids with static viscosities up to 2000 poises are given for the frequency range 25-150 kc/s. High frequency data (5-25 Mc/s) for the same liquids obtained by a method previously reported on [Abstr. 6803 (1951)] are correlated to the present work. Some results for polypropylene, polyisoprene, polybutadiene, and polypropylene sebacate are also given.

A.

534.23

6346. Mechanism of acoustic absorption in tissue. W. J. FRY. *J. Acoust. Soc. Amer.*, 24, 412-15 (July, 1952).

A viscous mechanism for the absorption of ultrasonic energy in tissue is considered. It is shown that the viscous forces acting between a suitably chosen distribution of suspended particles or structure elements and a suspending liquid can account for the experimentally observed linear relations between

acoustic absorption coefficient and ultrasonic frequency. The frequency band over which linearity obtains is determined by the limits of the distribution of values for the parameters which describe the structure elements. Below the linear range the relation becomes quadratic, in agreement with experiment, and at "high" frequencies a limiting value is approached asymptotically. A.

534.23 : 541.14

6347. The chemical effects of ultrasonics. V. GRIFFING. *J. Chem. Phys.*, **20**, 939-41 (June, 1952).

A study of the effects of ultrasonics on the inversion of sucrose was made and negative results were obtained. In the light of these results one can make the following conclusions. Chemical reactions attributed to ultrasonics can be classified according to three mechanisms. (1) Reactions due to cavitation never occur without the formation of bubbles. All of these reactions take place in the gas phase, are primarily thermal and are due to the heat developed during adiabatic compression. Thus, only reactants with an appreciable vapour pressure are affected. (2) Many reactions in the liquid phase are of secondary origin due to reactions with dissolved products of the primary reaction in the gas phase. Luminescence is also a secondary effect. (3) Some reactions are due to the uniform temperature elevation caused by absorption of acoustic energy of very high intensity in a short path length. A.

534.23 : 541.182.5

6348. Ultrasonic attenuation in gels. A. M. SRIVASTAVA. *Indian J. Phys.*, **25**, 491-503 (Oct., 1951).

In a theoretical discussion the propagation in a medium having spherical particles suspended in a liquid medium is evaluated theoretically. The attenuation per unit volume of such a medium is given by $\alpha = 2\pi na^3(\rho_0/\rho)q.k$, if the effect of scattering is also considered. From the theoretical considerations given in this paper, the attenuation is calculated for a few gels, showing the dependence upon temperature. The results are satisfactorily explained by the theory outlined in the paper. Using an ultrasonic pulse technique, the attenuation for a few gels was determined, and its variation with temperature and frequency studied. The diminution of the kinematic viscosity at higher temperatures and the increase in the scattering account for the values of attenuation showing a maximum near about 55°C. A.

534.232 : 534.612

6349. The use of phosphorescent materials to detect ultrasound. L. PÉTERMANN. *Helv. Phys. Acta*, **24**, 596-9 (No. 6, 1951) In French.

The method described has been used to determine the intensity of radiation over the surface of ultrasonic transducers, the method giving qualitative but not quantitative information. The phosphorescent material consists of ZnS and Ca-SrS coated over a thin plate which is exposed to a bright light for a few minutes. After exposure, it is immediately placed nearly in contact with the ultrasonic radiator. The temperature rises most in the plate in the areas of maximum sound intensity, and thus causes maximum reduction of phosphorescence at these sites. After

exposure to the ultrasound, the phosphorescent plate is kept in the dark and, as quickly as possible, exposed against a photographic film or plate, giving an image indicating clearly the areas of maximum intensity on the ultrasonic transducer. A. C. WHIFFIN

534.26

6350. Scattering of plane waves by soft obstacles. III. Scattering by obstacles with spherical and cylindrical symmetry. E. W. MONTROLL AND J. M. GREENBERG. *Phys. Rev.*, **86**, 889-97 (June 15, 1952).

For Pt II, see Abstr. 137 (1952). A new variational method is devised for obtaining the "best" parameters for trial wave functions of a given type for insertion into the integral equation for the scattering of scalar plane waves by obstacles with spherical and cylindrical symmetry. The variational procedure is applied to the determination, in the least square sense, of the square well potential which most closely approximates the potential under consideration for a given propagation constant ($k_0 = 2\pi/\lambda_0$) of the incident wave. As a trial function in the scattering integral equation the sphere (or cylinder) wave function (with the "best" parameters) which was derived in Pts I and II is then used. The differential and total scattering cross-sections for scattering by Gaussian, exponential and screened Coulomb potentials are obtained in simple closed forms. The Born approximation predicts the ratio of the total scattering cross-section to πb^2 (where b is qualitatively the effective range of the scatterer) to be a monotone increasing function of $2\pi b/\lambda_0$, while in the authors' theory it is a bounded function. The main advantage of the procedure developed in this paper is that, while it is superior to the Born approximation, especially for large b/λ_0 , it is equally simple to apply. A.

534.26

6351. Sound scattering by thin elastic shells. M. C. J. JUNGER. *J. Acoust. Soc. Amer.*, **24**, 366-73 (July, 1952).

The theory of scattering of plane waves of sound is extended to scatterers in the form of thin elastic shells of cylindrical and spherical shape. As for all elastic scatterers, the scattering action is the resultant of: (1) "rigid body scattering," i.e. the scattering which would be present if the scatterer were rigid and immovable; (2) "radiation scattering," which represents the sound radiation from the shell undergoing forced vibrations under the influence of the incident wave pressure, and which is determined by the dynamic characteristics of the submerged shell. Contrary to solid scatterers, whose dynamic characteristics are little different in vacuum and in the fluid medium, the characteristics of shells are profoundly altered by fluid reaction. When the shell is excited near resonance, the scattering pattern resembles the dynamic response of the shell in that it is highly frequency sensitive. The mathematical analysis proceeds by correlating the general solution of the wave equation in the fluid medium with the Lagrange equations of the elastic shell; the correlation is obtained by applying one boundary condition and by expressing the energy exchange between the two media in terms of generalized forces. This method should be applicable whenever (1) the solution of the wave equation is known in the appropriate co-ordinate system; (2) the

situations of motion of the elastic scatterer freely vibrating in vacuum can be derived and solved. A.

534.321.9 : 548.0 : 539.319

Effect of ultra-sound on stress distribution in a monocrystal of a solid solution of the bromide and iodide of thallium. See Abstr. 6801

534.321.9 : 621.395.63 : 621.389

352. Ultrasonic system detects intruders. S. EMPNER. *Electronics*, **25**, 104-5 (April, 1952).

An ultrasonic burglar alarm system for use in a confined space is described. It works on the Doppler principle, and consists of an ultrasonic oscillator, magnetostriction transmitting and receiving transducers and a tuned receiver. Transmitter and receiver are contained in a master control unit to which the transducers are connected by shielded cables. Output from the Hartley oscillator driving the transmitter is fed into the receiver circuit. The space to be protected is filled with energy of a frequency slightly above the f. range from the transmitter, so setting up a fixed standing-wave pattern. Accordingly, the received frequency normally remains constant. Any movements in the space, however, causes a frequency shift above or below normal, depending upon the direction of the movement. The difference in pitch is picked up by the receiver, amplified and used to operate an alarm. The presence of a flame also sets off the alarm because of the change in air density. Tamper switches release the alarm relay if attempts are made to disable the system. Furthermore, a small motor-driven vane, which can be actuated from a control station, enables the system to be tested. A single station will protect a volume of up to 20 000 ft³.

H. G. M. SPRATT (R)

534.7 : 612.85

Physiological acoustics. Hearing. See Abstr. 963-5

534.781

353. An experimental study of speech-wave probability distributions. W. B. DAVENPORT, JR. *J. Acoust. Soc. Amer.*, **24**, 390-8 (July, 1952).

Measurements were made of the first-probability distribution and of various conditional probability distributions of the speech wave instantaneous amplitude. Results obtained for several speakers indicate that the first-probability distribution varies exponentially with large values of amplitude and that increases in the conditional probabilities are noted for delay times of the order of magnitude of the pitch period. Measurements were also made of the first-probability distribution of the duration of the speech-wave zero-crossing periods, and of the auto-correlation function of clipped speech. These measurements were of the stationary, or "long time," speech-wave probability distributions. Most of the results are for speech waves recorded in an anechoic chamber. Some results are included for voices recorded in a live studio. A.

534.785

354. Multiple Helmholtz resonators. C. S. MCGINNIS AND V. F. ALBERT. *J. Acoust. Soc. Amer.*, **24**, 374-9 (July, 1952).

The explanation of the acoustical action of multiple Helmholtz resonators, except for one and two cavities,

has not been developed. Application of Lagrange's method is made to obtain the equations of motion of the fluid displacements. The equation for the frequencies of resonance is obtained by placing the determinant of the coefficients of the displacements equal to zero. The calculations yield a number of resonances equal to the number of cavities in the system. These are found to be in agreement with the experimental results. This physical method of approach, rather than synthetic electrical circuit theory, affords, among other applications, a more direct and more informative method for explaining the resonances of the vocal tract. A.

534.843

6355. The acoustic significance of the amplitude and phase of harmonics present in a source of sound in a room. J. G. ROBBINS. *J. Acoust. Soc. Amer.*, **24**, 380-3 (July, 1952).

In order to obtain some further measure of the acoustic properties of a rectangular room, a brief subjective study is made of listener response to sounds having various degrees of modulation on their decay curves and to alternate sounds which differ only in the phase relation of a harmonic in the source with respect to the fundamental frequency. The data show that the average listener finds the decay of sounds pleasant in inverse proportion to the amount of modulation on the decay curves, and that a large majority of listeners cannot distinguish between two steady-state sounds, alike except that in one sound the phase of a harmonic is changed with respect to that of the fundamental frequency. Also, an objective study is made of the modulation on decay curves. A switching device is used to insure a smooth cutoff at any predetermined phase of the fundamental frequency. The data show that, if the source includes the fundamental frequency and a harmonic at equal amplitudes, the modulation of the decay curve consists of two superposed modulations. The phase relations and amplitudes of these modulations are dependent on the phase relations and amplitudes of the driving frequencies which produce them. A.

534.845

6356. Comparative measurements of sound absorption, 1950. A. EISENBERG. *Akust. Beih.*, No. 2, AB108-AB114 (1952) In German.

Refers to measurements of absorption in materials and the reverberation times of concert halls over a wide frequency range made in Göttingen, München, Braunschweig, Stuttgart, Hamburg, Essen. Curves are given showing sound decay as a function of frequency and reverberation times for halls of various sizes. A. B. WOOD

534.861

6357. Review of halls for electroacoustic transmission. H. ETZOLD. *Funk u. Ton*, **6**, 191-7 (April, 1952) In German.

Reference is made to the physical, physiological and psychological aspects of sound transmission via microphone-loudspeaker in various concert halls and churches. Curves are shown relating reverberation time with frequency in the concert hall in Philadelphia, the concert hall in Amsterdam and in the Jesus-Christus Kirche in Berlin-Dahlem. A. B. WOOD

OPTICS . RADIATION . SPECTRA 535

535.018.3/.4

6358. Units and standards of measurement employed at the National Physical Laboratory. II. Light: photometry, colorimetry, radiometry. Department of Scientific and Industrial Research. London, H.M. Stationery Office (1952) 8 pp.

See Abstr. 747 (1952).

535.1

6359. Moments of inertia and moments of illumination of the image of a point. P. M. DUFFIEUX. *Rev. Opt. (Théor. Instrum.)* 31, 265–82 (June, 1952) In French.

The mean path of a beam of light may be defined mechanically as the trajectory of the centre of gravity of the energy it conveys, and the mean dispersion around this centre of gravity can be calculated by moments of inertia.

P. M. DAVIDSON

535.1 : 530.12 : 531.18

6360. Phase and group velocities in relativistic optics. J. L. SYNGE. *Rev. Opt. (Théor. Instrum.)* 31, 121–2 (March, 1952) In French.

By a simple argument based on Lorentz-invariance, the relation $c_p c_g = c_1^2$ between phase and group velocities is established, thus confirming the assertion of Ditchburn [Abstr. 1794 (1948)] that this relation is required by the special theory of relativity.

A.

535.22

6361. The velocity of light. L. ESSEN. *Sci. Progr.*, 40, 54–70 (Jan., 1952).

A review of recent measurements, and a tabulation of the results, with estimated errors.

535.22 : 535.343.4 : 539.133

6362. The velocity of light determined by the band spectrum method. D. H. RANK, R. P. RUTH AND K. L. V. SLUIS. Letter in *Phys. Rev.*, 86, 799 (June 1, 1952).

Investigation of the HCN vibration overtones with a grating and Fabry–Perot etalon gives B_0 to be $1.47830 \pm 0.000025 \text{ cm}^{-1}$ for the ground state. Comparison with the microwave value [Abstr. 6400 (1952)] $44315.9 \pm 0.25 \text{ Mc/s}$ gives $c = 299776 \pm 7 \text{ km/sec}$.

D. H. WHIFFEN

535.233

6363. The spectral emissivities of iron, nickel and cobalt. H. LUND AND L. WARD. *Proc. Phys. Soc. [Lond.] B*, 65, 535–40 (July, 1952).

The emissivities have been measured by the direct comparison of surface and black body radiation at temperatures between 1000°C and 1300°C , over the wavelength range 1.0μ to 2.6μ , using a PbS cell and amplifier as the detecting unit. Values of the temperature coefficients of emissivity referred to 1000°C indicate an X point for iron at 1.6μ , but none for Ni in this spectral range. The results for Co show an anomaly at a temperature close to the Curie point.

535.245.2 : 621.327.43 : 628.9

6364. Relation of distance to candle-power distribution from fluorescent luminaires. C. E. HORN, W. F.

LITTLE AND E. H. SALTER. *Illum. Engng [N.Y.]* 47, 99–104 (Feb., 1952).

An investigation of the effect of the distance of measurement on the values of luminous intensity obtained for fluorescent lamps and fittings. Not only the effect of size of source but also the error due to inter-reflection between lamps in multi-lamp fittings was determined experimentally. The results are given in extenso, and it is concluded that values obtained at comparatively short distances can be corrected to those which would be obtained at ∞ . The suggestion is made that the distribution from a lamp or fitting should be described in terms of the values obtained at a distance of at least $5 \times$ the max. dimension of the fitting.

J. W. T. WALSH (R)

535.247.1 : 771.531

6365. Photometric papers sensitive only to short wave ultraviolet. L. CHALKLEY. *J. Opt. Soc. Amer.*, 42, 387–92 (June, 1952).

The present work provides materials for recording and measuring this region with the ease of a photographic printing out process. The basis of the new papers lies in the activation of triphenylmethane dye cyanides so that they will react to ultraviolet with the formation of the associated dyes. Activators have been found that produce photosensitive mixtures suitable for use on paper. The sensitized papers print out fully formed, permanent images. Materials are described that are sensitive to $3250 \text{ \AA}$ and shorter and to $3350 \text{ \AA}$ and shorter wavelengths but are quite unaffected by sunlight through such a colourless glass as Corning No. 7380. Actinometers may be prepared to measure the short wave ultraviolet output of lamps, the erythral component of sunlight and dosages of therapeutic ultraviolet. Another use for the papers is in recording instruments where a beam of ultraviolet may be employed to trace a line on the moving paper, which is fully visible behind a window of colourless ultraviolet-absorbing glass.

A.

535.315

6366. Formulae for the tolerances to be imposed on prisms. A. BIOT. *Rev. Opt. (Théor. Instrum.)* 31, 283–5 (June, 1952) In French.

A theoretical investigation of the deviation of the refracted ray produced when one surface of a prism is inclined at a small angle to its correct position. The effect is calculated from the deviation produced by the small prism thus introduced.

N. CORCORAN

535.317 : 621.397.6

6367. A 5 : 1 television zoom lens. H. H. HOPKINS. *Instn Elect. Engrs Paper* 1353, 4 pp. [Early Proof Issue] [Television Convention, 1952].

The zoom lens is a complex objective whose focal length may be varied continuously over a wide range so that the scale of the image formed by it is similarly varied. The image remains stationary during this scale change and so stays in focus on the film or photocathode receiving it. The requirements of such a lens are discussed and a system fulfilling them is described. A short account of the aberration of lens systems is included, and also of the manner in which stable correction of these aberrations is achieved. The specification of a typical lens having a 5 : 1 variation in focal length is given.

R. W. FISH (R)

535.317.25
6378. Method permitting the improvement of resolving power of optical instruments. A. MARÉCHAL and P. LACOMME. *C.R. Acad. Sci. [Paris]* **234**, 155–6 (May 5, 1952) *In French*.

A method is suggested whereby resolution can be made possible when the two objects are nearer than required by Rayleigh resolution. This can be effected by means of an absorbing screen which absorbs a part of the central maximum of the diffraction pattern and thus at the expense of intensity improved resolution is possible. The final image has a central maximum more suitable for resolution. The optical system is discussed. S. TOLANSKY

535.317.4
6379. Primary aberrations and conjugate change. G. WYNNE. *Proc. Phys. Soc. [Lond.] B*, **65**, 429–37 (June, 1952).

Expressions are derived, in terms of the functions normally used in optical designing, for the variation with conjugates of the primary aberrations of any symmetrical system with isotropic object and image spaces. The possibilities of invariance of the aberrations, or their simultaneous correction for more than one magnification, are discussed. A.

535.323
6370. Refractive indices of cesium bromide. W. S. RODNEY AND R. J. SPINDLER. Letter in *J. Opt. Soc. Amer.*, **42**, 431 (June, 1952).

A table of preliminary results is given. The refractive index varies from 1.5960 to 1.7514 in the wavelength range 34.48 to 0.3650 microns.

H. G. JERRARD
535.323 : 535.345
6371. An improved method for measurements of optical constants by reflection. D. G. AVERY. *Proc. Phys. Soc. [Lond.] B*, **65**, 425–8 (June, 1952).

At wavelengths outside the photographic range the determination of the optical constants of absorbing media involves the measurement of intensity changes on reflection at the surface of the medium. A review of previous methods for their determination is made and the experimental difficulties are indicated. A method is described which surmounts some of these difficulties by avoiding the direct measurement of reflection coefficients. The accuracy to be expected from the method and an example of its use are briefly discussed. A.

535.324/.325 : 538.614
6372. Rotativities and refractivities of propane and of butane. R. DE MALLEMANN, F. SUHNER AND J. GRANGE. *C.R. Acad. Sci. [Paris]* **234**, 2247–9 (June 4, 1952) *In French*.

The magnetic rotativities, densities and refractive indices of gaseous and liquid C_3H_8 and C_4H_{10} at several temperatures and pressures for $\lambda = 578 \mu$ are tabulated. G. I. W. LLEWELYN

535.327
6373. The effect of pressure on the refractive index of water at freezing point. M. SATÔ. *Proc. Japan. Acad.*, **26**, 36–7 (July, 1950).

The change in refractive index of water on freezing is calculated on the assumption that it is due to a transformation pressure of 3280 atmospheres esti-

mated by Honda (1949) for a mass of water freezing from the outside towards the inside. Agreement with measured values is claimed. M. R. HOPKINS

535.33.03
6374. A modification of the Millikan spark for the far u.v. N. ASTOIN. *C.R. Acad. Sci. [Paris]* **234**, 2055–7 (May 19, 1952) *In French*.

Describes a spark source, in which the gaseous breakdown occurs along a surface, suitable for providing radiation in the wavelength range 80–1100 Å.

J. D. CRAGGS
535.33.03
6375. A shutter-illumination device for the study of phototropic dyes. J. H. GOULD AND W. R. BRODE. *J. Opt. Soc. Amer.*, **42**, 380–2 (June, 1952).

In order to study the phototropism exhibited by certain monoazo dyes more completely, a shutter and a sample illuminator were constructed for use with a Cary recording quartz spectrophotometer. By use of this device the dye solutions can be exposed to a strong light source during the dark periods of the chopping shutter of the instrument. In this way solutions which show a very rapid phototropic change can be studied. A.

535.33.03
6376. Spectra of flames supported by free atoms. A. G. GAYDON AND H. G. WOLFHARD. *Proc. Roy. Soc. A*, **213**, 366–79 (July 8, 1952).

The spectra of the "atomic flames" of organic compounds with the products of discharges through O, H and water vapour have been examined. Hydrocarbons give bright flames with water products but not, contrary to previous reports, with dry atomic H. CCl_4 and other organic halides and also CS_2 do give bright flames with H. The rotational intensity distribution in the OH band in most atomic flames corresponds to a very high temperature, around 8000°K; it is high for methyl alcohol with water products, but only around 2500°K for methyl alcohol with atomic O. The flame of acetylene with products from heavy water, D_2O , gives mainly OD and CD rather than OH and CH bands. The mechanism of formation and excitation of CH and OH in flames is discussed. When Fe carbonyl is introduced into atomic flames very high electronic excitation of Fe atoms is observed, as in the reaction zones of ordinary premixed flames; this high excitation is also observed for the flame of CCl_4 with atomic H. A.

535.33.03 : 621.3.014.31 : 621.311.6
6377. Electronically controlled a.c. interrupted arc source for spectrographic purposes. A. BARDOCZ. Letter in *J. Opt. Soc. Amer.*, **42**, 357–9 (May, 1952).

Describes, with detailed circuit diagram, a new system for the excitation of spark/arc spectra. The circuits were developed to give stable, accurately repeatable, electrical conditions for the discharge.

J. D. CRAGGS
535.33.07
6378. Minimizing anomalies in reflectance measurements with the Beckman quartz spectrophotometer. H. K. HAMMOND, III AND I. NIMEROFF. *J. Opt. Soc. Amer.*, **42**, 367–72 (June, 1952).

The Beckman spectrophotometer Model D.U. has proved to be a useful instrument for measuring spectral

directional reflectance. Like other spectrophotometers it is subject to slit-width and stray-energy errors. The magnitude of these errors and techniques for minimizing them are discussed. The viewing geometry and an adaptor for four-inch square specimens are described. A.

535.33.07

6379. Double-pass, virtual twin-beam monochromator. W. A. SHURCLIFF. Letter in *J. Opt. Soc. Amer.*, **42**, 433 (June, 1952).

A Perkin-Elmer, Walsh-type, monochromator could be altered to a double-beam type. The chopper would be removed and the beam caused to pass alternately through the test and reference samples. A. G. GAYDON

535.33.087.9 : 518.5

A semi-automatic graphical counter with use in spectroscopy. See Abstr. 6240

535.337 : 537.525

Influence of Joshi effect on the emission spectrum of chlorine. See Abstr. 6538

535.338

6380. On the arc spectra of boron, indium, thallium, lead, and bismuth. H. E. CLEARMAN. *J. Opt. Soc. Amer.*, **42**, 373–80 (June, 1952).

Observations have been made in the range 1200–2000 Å. The analysis of Bi I and Bi I has been considerably extended with the aid of these observations, while new levels have been found in In I, Tl I and Pb I. A.

535.338.3

6381. The sixth series in the hydrogen spectrum. C. J. HUMPHREYS. Letter in *J. Opt. Soc. Amer.*, **42**, 432 (June, 1952).

The atomic line $6h^2H^0 - 7i^2I$ has been observed at 12.37μ in a heavy-current discharge through water vapour. A. G. GAYDON

535.338.333

6382. Spectro-isotopic assay of lithium. G. L. STUKENBROEKER, D. D. SMITH, G. K. WERNER AND J. R. McNALLY, JR. *J. Opt. Soc. Amer.*, **42**, 383–6 (June, 1952).

The isotope spectrum shift in the 6707.8 Å resonance line of Li has been used for the assay of the isotopes Li^6 and Li^7 . A hollow cathode source loaded with 4 mg of Li_2SO_4 is excited at 35 mA using purified He at about 2 to 3 mm pressure as support gas. Characteristics, such as tube geometry, pressure, sample life, flow rate of gas, current and anode-cathode spacing have been studied to give reproducible line intensity ratios. Precision of the method based on a 95% confidence interval is about 6% of the Li^6 content or, by difference, about 0.5% of the Li^7 content in natural material. Spectra are obtained with a 21 ft, 30 000 lines per in grating spectrograph using first order for which the $\text{Li}^6\text{-Li}^7$ isotope shift of 0.159 Å is readily separated. A multiplier phototube (1P28) set on the 4603 Å Li line is used in an integrating circuit as an exposure meter. A.

535.338.334

6383. The pressure broadening of the neon spectral lines. K. LANG. *Acta Phys. Austriaca*, **5**, 376–89 (No. 3, 1952) In German.

Experimental. The width at half maximum of all lines was found to be proportional to the pressure of

the gas. The effect is markedly larger for singlet lines. L. PINCHERLE

535.338.334

6384. A method of synthesis of the statistical and impact theories of pressure broadening. P. W. ANDERSON. Letter in *Phys. Rev.*, **86**, 809 (June 1, 1952).

Deduction of a general mathematical expression for pressure broadening of spectrum lines. The expression reduces to the forms for impact and statistical theories at the proper limits. A. G. GAYDON

535.338.334–14

6385. Broadening of microwave absorption lines by collision with the cell walls. R. H. JOHNSON AND M. W. P. STRANDBERG. Letter in *Phys. Rev.*, **86**, 811 (June 1, 1952).

Theoretical investigation suggests that earlier formulae for wall collision half-width of absorption lines are too small by a factor of about 6. Preliminary microwave results agree with the new theory. D. H. WHIFFEN

535.338.4

6386. Rotational structure of the (1, 0), (2, 1) and (3, 2) bands of the nitrogen first positive system. P. K. CARROLL. *Proc. Roy. Irish Acad.*, **54 A**, 369–97 (No. 22, March, 1952).

The detailed analysis, including evaluation of the Λ -type doubling in $B^3\Pi$ and the spin-splitting in $A^3\Sigma$, is given. For $A^3\Sigma$, $B_v = 1.4500 - 0.0183(v + \frac{1}{2})$, and for $B^3\Pi$, $B_v = 1.6386 - 0.0185(v + \frac{1}{2})$. No evidence for predissociation in $v = 3$ of $B^3\Pi$ was found. R. F. BARROW

535.338.4

6387. A mechanism for active nitrogen. R. W. NICHOLLS. Letter in *J. Chem. Phys.*, **20**, 1040 (June, 1952).

It is suggested that collisions of N_2 molecules in the metastable $a^1\Pi_g$ state with slow electrons might lead to formation of molecules in the $B^3\Pi_g$ state, and hence contribute to the afterglow. A. G. GAYDON

535.338.4 : 551.593.9

The airglow. See Abstr. 6937

535.338.4 : 551.594.5

Lines and bands in the spectrum of the aurora. See Abstr. 6941–2

535.338.42

6388. Observation of vibration-rotation bands of the molecule OH in oxy-hydrogen and oxy-acetylene flames. G. DÉJARDIN, J. JANIN AND M. PEYRON. *C.R. Acad. Sci. [Paris]* **234**, 1866–8 (May 5, 1952) In French.

Wavelengths of lines observed in the region $7150\text{--}9615 \text{ Å}$ are given. R. F. BARROW

535.343–15

6389. Infrared spectroscopy of the hydrogen bond at low temperatures. V. N. NIKITIN AND N. G. YAROSLAVSKIĖ. *Dokl. Akad. Nauk SSSR*, **77**, 1015–18 (No. 6, 1951) In Russian.

535.343–15 : 535.375.5

6390. Raman and infrared absorption spectra of ozonides. E. BRINER, B. SUSZ AND E. DALLWIGK. *C.R. Acad. Sci. [Paris]* **234**, 1932–4 (May 12, 1952) In French.

The ozonides of several organic compounds have

been examined with a view towards elucidating the mechanism of their formation and decomposition. The spectra of *trans*-stilbene in CCl_4 containing various concentrations of ozone are given.

G. I. W. LLEWELYN

535.343.2-14 : 539.133

6391. Microwave spectroscopy at high temperature—spectra of CsCl and NaCl. M. L. STITCH, A. HONIG AND C. H. TOWNES. Letter in *Phys. Rev.*, **86**, 813 (June 1, 1952).

Using cell temperatures up to 875°C , lines are observed leading to the distances $2.3606 \pm 0.0003 \text{ \AA}$ in NaCl and 2.9041 ± 0.0003 in CsCl, and also showing TiCl to be more than diatomic.

D. H. WHIFFEN

535.343.3

6392. Modifications of the absorption spectra of anions induced by complex formation. L. I. KATZIN. *J. Chem. Phys.*, **20**, 1165-9 (July, 1952).

The absorption of thiocyanate, chloride, bromide and iodide ions are markedly altered on complexing with nickelous or cobaltous ions in isopropyl alcohol solution, new peaks appearing at longer wavelengths. In the case of iodide ion, the absorption spectra of the complexes with nickelous ion, cobaltous ion and iodine (the "tri-iodide" complex) are practically distinguishable only by their extinction coefficients. A characteristic feature of the modified iodide spectrum is the pair of peaks, found at shorter wavelengths in the spectra of the free iodide ion, and in other forms. The cobaltous complexes with bromide and chloride ions show analogous splittings, but the absorption of the trihalide ions show single peaks which agree in wavelength with the longer wavelength peak of the cobalt-complexed ion. The nickelous complexes absorb at shorter wavelengths. A.

535.343.3-15

6393. The infrared spectrum of pyrrole and the hydrogen bond. P. TUOMIKOSKI. Letter in *J. Chem. Phys.*, **20**, 1054-5 (June, 1952).

The associated band of the NH absorption spectrum can be interpreted as resulting from the orientation of the NH groups towards highly polarizable regions in neighbouring molecules. This is to be distinguished from conventional hydrogen bonding.

H. H. GREENWOOD

535.343.3-15

6394. On the complexity of the N-H stretching vibration band in pyrrole and indole. N. FUSON AND M.-L. JOSIEN. Letter in *J. Chem. Phys.*, **20**, 1043 (June, 1952).

The structure of the fundamental suggested association. This is not supported by analysis of the 3rd harmonic in the way previously supposed [Abstr. 2616 (1952)].

H. H. GREENWOOD

535.343.31-15

6395. The infrared absorption spectra of *cis*- and *trans*-1,2-dichlorohexafluorocyclobutane. J. R. LACHER, A. BÜCHLER AND J. D. PARK. *J. Chem. Phys.*, **20**, 1014-15 (June, 1952).

535.343.31-15

6396. Infrared spectral data and tentative assignments for CF_3Br and CF_3I . P. R. MCGEE, F. F. CLEVELAND AND S. I. MILLER. Letter in *J. Chem. Phys.*, **20**, 1044 (June, 1952).

6397. On the infrared spectra of amino-acids in solution in heavy water. H. LENORMANT. *C.R. Acad. Sci. [Paris]* **234**, 1959-61 (May 12, 1952) In French.

A shift of carbonyl absorption from 6.37 to 6.18μ in passing from alkaline to neutral solution occurs with alanine but not with β -alanine in which the acid and amino groups are separated by a CH_2 group.

D. H. WHIFFEN

535.343.32-15

6398. On the infrared spectra of peptides in solution in heavy water. H. LENORMANT AND J. CHOUTEAU. *C.R. Acad. Sci. [Paris]* **234**, 2057-9 (May 19, 1952) In French.

Absorption bands in the 5.5 - 7.5μ region are correlated with structure and pH.

D. H. WHIFFEN

535.343.4 : 541.5

6399. Some observations on the CS "radical". P. J. DYNE AND D. A. RAMSAY. Letter in *J. Chem. Phys.*, **20**, 1055-6 (June, 1952).

Experiments on the preparation and life-time of gaseous CS are reported. CS is removed by a heterogeneous reaction: in the gas phase CS may have the chemical stability of a normal molecule.

R. F. BARROW

535.343.4-14 : 539.133

6400. The microwave spectrum and molecular constants of hydrogen cyanide. A. H. NETHERCOT, JR., J. A. KLEIN AND C. H. TOWNES. Letter in *Phys. Rev.*, **86**, 813 (June 1, 1952).

Revised accurate constants are given for HCN and DCN.

D. H. WHIFFEN

535.343.4-15 : 535.375.5

6401. Infra-red and Raman spectra of fluorinated ethylenes. III. Tetrafluoroethylene. J. R. NIELSEN, H. H. CLAASSEN AND D. C. SMITH. *J. Chem. Phys.*, **18**, 812-16 (June, 1950).

For Pt II, see Abstr. 5708 (1950).

535.343.4-15 : 535.375.5

6402. Infrared and Raman spectra of fluorinated ethylenes. IV. 1,1-difluoro-2-chloroethylene. J. R. NIELSEN, C. Y. LIANG AND D. C. SMITH. *J. Chem. Phys.*, **20**, 1090-4 (July, 1952).

The infrared absorption spectra of gaseous and liquid CF_2 :CHCl have been obtained in the regions 2 - 22μ and 2 - 38μ , respectively, with the aid of LiF, NaCl, KBr and KRS-5 prisms. The Raman spectrum of the liquid phase has been photographed with a three-prism glass spectrograph of linear dispersion $15 \text{ \AA/mm}$ at $4358 \text{ \AA}$. Relative intensities and depolarization ratios have been measured for the stronger Raman bands. A complete assignment of fundamental vibration frequencies is given, the spectra are interpreted in detail and thermodynamic functions are calculated for the temperature range 253 - 600°K .

A.

535.343.4-31

6403. The near ultra-violet band-system (D-X) of silicon monosulphide. A. LAGERQVIST, G. NILHEDEN AND R. F. BARROW. *Proc. Phys. Soc. [Lond.] A*, **65**, 419-32 (June, 1952).

The rotational analysis of the near ultra-violet band-system, $\text{D}^1\Pi - \text{X}^1\Sigma^+$, has been extended. Twelve bands have been analysed, namely the 7,1,

6,0, 6,1, 5,0, 5,1, 4,0, 4,1, 3,0, 2,0, 1,0, 1,1 and 0,0 bands. The constants derived for D^{II} are $B'_v = 0.2664_7 - 0.0021_6(v' + \frac{1}{2})$; $D'_v = [2.91 - 0.03(v' + \frac{1}{2})] \times 10^{-7}$; $G'_v = 513.1_2(v' + \frac{1}{2}) - 2.9_3(v' + \frac{1}{2})^2$; $v_e = 35\,026.8_6 \text{ cm}^{-1}$; $r'_e = 2.058_3 \text{ \AA}$. A number of perturbations have been found in the upper state. They appear to arise from interactions with two electronic states, a $^3\Sigma^-$ state and a singlet state, $^1\Pi$ or $^1\Delta$. It has not been possible to determine the absolute numbering of the vibrational levels of the perturbing states, but in all other respects fairly complete information has been obtained about the $^3\Sigma^-$ state. The perturbations are similar to those already known in the spectrum of CO, and the analogy between the electronic states of the molecules is thus strengthened.

A.

535.343.4-32

6404. Ultraviolet absorption spectrum of cyclopentanone in the gaseous phase. M. LESTRADE AND P. THOUVENIN. *C.R. Acad. Sci. [Paris]* **234**, 2183-5 (May 26, 1952) *In French*.

This spectrum is purely vibrational, as the moments of inertia are too high for the rotation to appear in this region. A detailed analysis of the bands is given.

A. J. TAYLOR

535.343.4-32

6405. Schumann region absorption spectrum of copper vapour. W. R. S. GARTON. Letter in *Proc. Phys. Soc. [Lond.] A*, **65**, 461-2 (June, 1952).

Assignments are given for 3 of 15 new lines in the region 1200-1430 Å.

G. F. LOTHIAN

535.345

6406. Effect of temperature on the spectral transmission of coloured glass. S. G. YUROV AND V. S. KHAZANOV. *Izv. Akad. Nauk SSSR, Otdel Tekh. Nauk*, No. 12, 1792-1800 (1951) *In Russian*.

Sixty different glasses of Russian manufacture all exhibited significant variation in spectral transmission ($\lambda = 4100 - 7200 \text{ \AA}$) over the range -40°C to 200°C . Transmission characteristics, of which 5 examples are given, were reversible, and some had up to 3 "nodes" of change of sign of temperature coefficient of transmission. Glasses most affected were those coloured with Se, Cd (yellow, orange, red); and Cr, Cu (green). The effect on various applications of coloured glass is estimated; e.g. a change in the temperature of an optical pyrometer of 10°C could result in a 50°C error in its reading.

F. QUELON

535.345

6407. The pressure dependence of the absorption by entire bands of water vapor in the near infrared. J. N. HOWARD AND R. M. CHAPMAN. *J. Opt. Soc. Amer.*, **42**, 423-6 (June, 1952).

A study was made of the total absorption of 5 water-vapour bands between 1μ and 7μ , using a multiple-reflection absorption cell in which optical path length, water-vapour density and total pressure could be varied independently. Absorption was determined as a function of these parameters. For the range of concentrations studied it was found that the fractional absorption of an entire band can be represented by an error-function formula $A =$

$$\text{erf}(t) = 2/\pi^{1/2} \int_0^t e^{-x^2} dx, \quad \text{where} \quad t = \frac{1}{2}(\pi w)^{1/2}(P_T +$$

$P_P/760)^{1/2}$. Here w is the water-vapour concentration, P_T the total pressure and P_P the partial pressure of the water-vapour. The quantity t in this formula is very nearly proportional to the fourth root of the pressure. Values of the "generalized absorption coefficient" β are determined for the 5 bands.

A.

535.345-15

6408. Infra-red absorption by metals at low temperatures. K. G. RAMANATHAN. *Proc. Phys. Soc. [Lond.] A*, **65**, 532-40 (July, 1952).

The infrared absorptivities of several electropolished metal surfaces have been measured at liquid helium temperatures with a specially designed radiation cryostat with a black body at room temperature as the source and a differential helium gas thermometer as the detector. It is found that the absorptivity of tin at 1.95°K for the mean estimated wavelength 14μ remains the same in the normal and superconducting states to within a probable error of 0.3%. The absorptivities of the normal metals, which include a number of alloys, are compared with the values calculated by various theories of metallic reflection. The classical Hagen-Rubens formula is found to be valid for the alloys except where there are complications such as the internal photoelectric effect. The absorptivities of the pure metals are in fair agreement with the values calculated by the anomalous skin effect theory neglecting relaxation effects.

A.

535.345-32

6409. Absorption at high temperature of some optical materials in the Schumann ultraviolet. A. GILLES. Letter in *J. Phys. Radium*, **13**, 247 (April, 1952) *In French*.

Corundum shows large increase of absorption at increasing temperatures up to 900°C . CaF_2 and LiF show very little variation.

G. F. LOTHIAN

535.371

6410. On the fluorescence in diamond excited by X-rays. B. M. BISHUI. *Indian J. Phys.*, **25**, 575-80 (Dec., 1951).

The fluorescence of four specimens of diamond of Type I (common) and of one specimen of diamond of Type II (rare) was excited by X-rays and the spectra photographed with a spectrograph of high light-gathering power and moderate dispersion. The spectra are compared with those excited by ultraviolet light. All the four specimens of Type I showed continuous fluorescence extending from $5650 \text{ \AA}$ up to about $3700 \text{ \AA}$. In the case of two specimens showing a strong absorption band at $4156 \text{ \AA}$, the fluorescence spectrum excited by X-rays showed an absorption band at this position accompanied by a few other similar bands on the shorter wavelength side. The diamond of Type II did not show any fluorescence in the visible region when irradiated by X-rays. These results are contradictory to those published by Ramachandran [Abstr. 293 (1947)] who claimed to have observed bands in the spectrum of fluorescence excited by X-rays in diamond of Type I, and weak fluorescence in diamond of Type II. It is shown that these results can be explained only on the hypothesis that the fluorescence is due to presence of chemical impurities in the lattice of diamond of Type I and that diamond of Type II contains no such impurity.

535.371

6411. Oscillographic study of transient emission. G. DESTRIAU AND J. MATTLER. *J. Phys. Radium*, **13**, 205-9 (April, 1952) In French.

The production of transient luminescence in previously excited phosphors by application of a.c. fields is studied. The emission is periodic with the field frequency. At low frequencies (50 c/s) the emission maxima lead the potential maxima, at higher frequencies (1800 c/s) they lag behind. Variation of decay of emission with time for different frequencies and field intensities is investigated. G. F. J. GARLICK

535.371

6412. Cadmium chlorophosphate phosphors. R. W. WOLLENTIN, C. K. LUI WEI AND R. NAGY. *J. Electrochem. Soc.*, **99**, 131-6 (April, 1952).

An investigation of this phosphor was undertaken to determine the possibilities of its use in the production of fluorescent lamps. Under 2537 Å excitation this phosphor fluoresces a yellowish pink with a peak of emission at 5900 Å. Studies were made of the effect of substitutions of cations for Cd on the output, emission, excitation and interlattice spacing of the phosphor. A.

535.371

6413. Calcium zinc silicate phosphor. R. NAGY, C. K. LUI WEI AND R. W. WOLLENTIN. *J. Electrochem. Soc.*, **99**, 137-9 (April, 1952).

Partial substitution of Zn for Ca in Pb-activated Ca silicate phosphor shifted the peak of emission from 3350 Å to 3450 Å. X-ray analysis indicated that the new phosphor had a tetragonal structure similar to the mineral hardystonite, rather than the monoclinic or triclinic calcium silicate. A.

535.371

6414. The zinc silicate phosphors fluorescing in the yellow and red. H. G. PFEIFFER AND G. R. FONDA. *J. Electrochem. Soc.*, **99**, 140-3 (April, 1952).

The spectral emission at room temperature and at 80°K of yellow and red fluorescing Zn orthosilicates prepared in various ways has been determined. The glassy state of the red phosphor has been confirmed. The yellow phosphor has been found to have some degree of crystallinity but its spectral emission is affected only slightly by the degree of crystallinity as determined by X-ray diffraction. A.

535.371

6415. The function of oxygen in zinc sulfide phosphors. F. A. KROEGER AND J. A. M. DIKHOFF. *J. Electrochem. Soc.*, **99**, 144-54 (April, 1952).

At 1200°C ZnS and ZnO form solid solutions of the composition ZnS — 1 mole % ZnO and ZnO — 0.3 mole % ZnS. The incorporation of ZnO in ZnS causes the appearance of a new absorption band and, in the presence of activators, of new fluorescence bands displaced about 150 Å toward longer wavelengths with respect to the original bands. These effects are explained by the assumption of separate oxygen levels 0.1 eV above the full band and of new centres consisting of associated pairs of oxygen and activator ions. The formation of such pairs is explained on the basis of the principle of compensation of volume. This principle also explains the favourable effect of O on the intensity of fluores-

cence. It is found to be the logical complement of the principle of compensation of charge introduced earlier in connection with the incorporation of ions of a certain valency in a base lattice consisting of ions of a different valency. It is shown that O gives rise to characteristic traps and has further a marked effect in combination with fluxes. The optical properties of ZnO-xZnS are briefly described and explained along similar lines. A.

535.371

6416. Zinc-magnesium oxide and zinc-magnesium sulfide phosphors. A. L. SMITH. *J. Electrochem. Soc.*, **99**, 155-8 (April, 1952).

Zn-Mg oxide phosphors were briefly investigated, and procedures developed for producing highly efficient phosphors containing no intentional additions of either activator or flux. True solid solutions of Zn and Mg sulphides exist up to at least 25 mole % MgS. With Ag or Cu as an activating agent, a shift in luminescence to shorter wavelengths occurs as the MgS content increases. With Mn activation, emission is not appreciably affected by the addition of MgS. Efficiencies are good under both ultraviolet and electron excitation, and a long-duration phosphorescence can be obtained by electron excitation of the Cu-activated materials. Pb, Sb, As and Bi can also be utilized as activators to give efficient phosphors. A.

535.371

6417. Correction and supplement to "Inertia effects in the stimulated emission of sensitized phosphors." P. BRAUER. *Ann. Phys. [Lpz.]* **10**, 282-5 (No. 4-5, 1952) In German. See Abstr. 905 (1952).

535.371

6418. Optical properties of calcium silicate phosphors. G. R. FONDA AND F. J. STUDER. Letter in *J. Opt. Soc. Amer.*, **42**, 360 (May, 1952).

Estimations of lead content in CaSiO₃-Pb phosphors and measurements of luminescence excitation and reflection spectra show that the latter properties are dependent on lattice structure and not on lead content [see also Abstr. 190 (1950)]. G. F. J. GARLICK

535.371

6419. On the physics of crystal phosphors. F. STRÖCKMANN. *Naturwissenschaften*, **39**, 226-33 (No. 10, 1952) In German.

The article gives an up-to-date review of the theories of luminescence processes in sulphide, silicate, tungstate, oxide and halide phosphor groups. Discussion is given of emission centres and electron traps in relation to chemical constitution, and of photoconductivity, photographic effects, reaction kinetics for phosphorescence, thermoluminescence and particle destruction of phosphors. G. F. J. GARLICK

535.371 : 537.312.5

6420. Far ultraviolet response of photomultipliers coated with fluorescent powder. S. ROBIN AND V. SCHWETZOFF. Letter in *J. Phys. Radium*, **13**, 239-40 (April, 1952) In French.

The spectral response of a combination of photomultiplier and fluorescent sodium salicylate is measured over the range 1500-3700 Å. The fluorescent material improves the response in the short u.v. by a factor of 10³. G. F. J. GARLICK

535.372
6421. The excitation spectra of various silicate phosphors. A. J. OSZY. *J. Electrochem. Soc.*, **99**, 159–63 (April, 1952).

A description is given of the excitation spectra of a number of silicate phosphors when irradiated by ultraviolet energy. Phosphors described are (a) Mn-activated ZnBe silicate, (b) Pb- and Mn-activated Ca silicate, (c) Ba silicate activated by Pb, and (d) Ba silicate activated by Pb and modified by the substitution of Mg. For the Mn-activated ZnBe silicates, the change of the excitation spectrum with the lattice constant is noted. For a number of the other phosphors, it is shown that the excitation spectra for the visible and ultraviolet bands are not the same. It is concluded that the mechanisms involved for the excitation of the two bands are different. A.

535.372
6422. Light emission from polonium. G. ORTNER AND S. SALIM. Letter in *Nature [Lond.]* **169**, 1060–1 (June 21, 1952).

The luminescence of Po deposited on Pt is examined with an *f*/1 glass spectrograph. Lines and identifications (mostly O II) and some continuous bands are listed. A. G. GAYDON

535.375.5
6423. On the origin of low frequency Raman lines in para-dichlorobenzene. A. K. RAY. *Indian J. Phys.*, **25**, 459–67 (Oct., 1951).

535.375.5
6424. The variations of frequency of a polar vibration, active in the Raman effect, as a function of the orientation of the vector of the wave with relation to the direction of the vibration. H. POULET. *C.R. Acad. Sci. [Paris]* **234**, 2185–7 (May 26, 1952) *In French*.

Mathematical. The fundamental vibration frequency varies with the square of the cosine of the angle between the direction of the vibration and the direction of propagation of the wave.

G. I. W. LLEWELYN

535.375.5 : 548.7
6425. Anomalies in the scattering spectrum of piezoelectric crystals. II. A study of quartz. J.-P. MATHIEU AND L. COUTURE-MATHIEU. *C.R. Acad. Sci. [Paris]* **234**, 1961–3 (May 12, 1952) *In French*.

For Pt I, see Abstr. 5684 (1952). Variation of frequency, intensity and polarization of certain Raman lines of quartz are explained by separation of elastic longitudinal and transverse waves in the crystal.

G. I. W. LLEWELYN

535.375.5 : 548.7
Raman spectra of isotopically diluted crystals. See Abstr. 6874

535.375.54
6426. Low frequency spectra of oxalic acid dihydrate. R. MARIGNAN AND L. BARDET. *C.R. Acad. Sci. [Paris]* **234**, 1964–5 (May 12, 1952) *In French*.

See Abstr. 3486 (1952). Results obtained using ordinary and polarized light in the frequency range 51–176 cm^{-1} are interpreted.

G. I. W. LLEWELYN

535.375.54 : 539.133
6427. The Raman spectrum and structure of *d*-tartaric acid. A. WEIL AND J.-P. MATHIEU. *C.R. Acad. Sci. [Paris]* **234**, 1868–70 (May 5, 1952) *In French*.

The structure proposed by Beevers and Stern

[Abstr. 4279 (1949)] is confirmed by determination of the intensity of the Raman lines for various orientations of the crystal.

G. I. W. LLEWELYN

535.376
6428. Scintillation response of organic crystals to low energy alpha-particles. J. W. KING AND J. B. BIRKS. Letter in *Phys. Rev.*, **86**, 568–9 (May 15, 1952).

The ratio of the experimental value of the specific fluorescence of organic crystal scintillators to that calculated from theory previously established for α -particles of 0–8 mm in air decreases from unity to 0.5 as the α range falls from 8 mm to zero. An extension of theory is proposed to explain this (see abstract following).

G. F. J. GARLICK

535.376
6429. Theory of the response of organic scintillation crystals to short-range particles. J. B. BIRKS. Letter in *Phys. Rev.*, **86**, 569 (May 15, 1952).

The original exciton theory [see Abstr. 207 (1952)] is modified for low-energy α -particle excitation of organic crystals by allowing for the effect of surface proximity on the behaviour of excitons produced.

G. F. J. GARLICK

535.376
6430. Electroluminescence by anodic polishing of zinc. M. KRIEG AND E. LANGE. Note in *Naturwissenschaften*, **39**, 208 (No. 9, 1952) *In German*.

Zinc surfaces arranged in soda-lye solutions and subjected to electrolytic polishing show feeble blue luminescence detectable by the dark adapted eye. The emission increases with current density and the polarization potential across the surface layer of ZnO (~ 5 V). The latter layer is visible on surfaces in weak solution (> 1 molar). At the normal solution concentration for polishing the emission requires current densities of 2 A/cm². A feeble effect was observed using phosphoric acid solutions.

G. F. J. GARLICK

535.39 : 539.234
6431. On the phase changes suffered by a plane wave at reflection or at transmission through a very thin metal film. F. ABELÈS. *C.R. Acad. Sci. [Paris]* **234**, 2053–5 (May 19, 1952) *In French*.

In a previous note [Abstr. 3495 (1952)] expressions were derived for reflecting and transmitting coefficients of a thin absorbing film. These calculations are extended here to include formulae for phase changes.

S. TOLANSKY

535.412
6432. The origin of Glauert's superposition fringes. S. C. HUNTER AND F. R. N. NABARRO. *Phil. Mag.*, **43**, 538–46 (May, 1952).

See Abstr. 929 (1952). It is shown that multiple reflections between the surfaces of the inserted sheet and the mirrors necessarily produce the types of distortion observed, and that the published photographs can be analysed quantitatively. A.

535.412
6433. An unusual birefringence interference pattern. S. TOLANSKY AND F. S. A. SULTAN. *Phil. Mag.*, **43**, 547–8 (May, 1952).

A phenomenon related to that described by

Glauert [Abstr. 929 (1952)] is described. A drop of molten *p*-toluidine crystallized between two silvered flats showed, in one region, two sets of fringes, polarized perpendicularly to each other, the fringes themselves being nearly at right angles. The crystal is evidently acting simultaneously as a "geometric" wedge and a perpendicular "optical" wedge.

535.417

6434. Precise topography of optical surfaces. J. B. SAUNDERS. *J. Res. Nat. Bur. Stand. [Wash.]* **47**, 148-55 (Sept., 1951).

The unit of length usually used in measuring optical surface features, by interference of light, is one-half the wavelength of the monochromatic light that is used. A method is described in which the unit of length is a much smaller fraction of the wavelength. Topographic maps of optical surfaces are made in which the contour interval is less than one-thirtieth the wavelength. The smallness of the unit depends upon the quality of the surfaces. Irregularities, too small to be detected with the Fizeau or two-beam fringes, are made to appear very prominent. Surface markings, caused by the final polishing actions, can be made to stand out in bold relief. A.

535.42 : 535.822.9

6435. Resolving power in diffraction microscopy with special reference to X-rays. A. V. BAEZ. Letter in *Nature [Lond.]* **169**, 963-4 (June 7, 1952).

The theory of the hologram is discussed in terms of Fresnel's zone patterns and resolving limits are derived. Observations show that it is feasible to obtain Gabor reconstructions with X-rays. They point to the possibility of making a Fresnel zone pattern by interference methods with visible light which might be reduced photographically and deposited on an optical flat of Be to yield a zone plate for X-rays. S. TOLANSKY

535.421

6436. Construction of a stigmatic mounting for a concave grating. J. ROIG, L. BOURDELET AND J. ROUSSEAU. *Rev. Opt. (Théor. Instrum.)* **31**, 286-303 (June, 1952) In French.

The properties of the concave grating and the principal methods of mounting it are briefly reviewed. The authors then describe the mounting developed at the Lille Institute of Physics; it is a modification of a Wadsworth stigmatic mounting, the light incident on the grating being collimated by a concave mirror. By using a small plane mirror between the slit and the concave mirror, the awkwardness of the mounting is considerably reduced without impairing the image quality. A.

535.421 : 535.33.07-15

6437. The use of diffraction gratings with an infra-red spectrometer. J. D. S. GOULDEN. *J. Sci. Instrum.*, **29**, 215-16 (July, 1952).

A simple experimental arrangement is described in which a plane replica grating is used to obtain high dispersion with an infra-red spectrometer in the 3μ region. The pre-monochromator unit for the grating spectrometer is built into the normal spectrometer radiation unit and uses the rocksalt prism of the spectrometer. A.

535.43 : 530.145 : 534.26

Scattering by obstacles of spherical and cylindrical symmetry. See Abstr. 6350

535.433

6438. Fraunhofer multiple slit diffraction patterns with finite sources. A. E. SMITH AND C. D. HAUSE. *J. Opt. Soc. Amer.*, **42**, 426-30 (June, 1952).

General expressions for the intensity distribution in Fraunhofer *N*-slit diffraction patterns with finite sources both in the form of a uniformly radiating slit and disk have been obtained. By making use of the secondary maxima in the multiple slit patterns and their dependence upon source dimensions it is shown that multiple slits give a limited but useful advantage over double slits for the determination of the angular extent of distant sources. Results indicate an effective increase in resolution of $1/N$, $N > 2$. This is verified experimentally. A.

535.435

6439. Experimental contribution to the study of light scattering by solutions containing very long particles. P. HORN. *C.R. Acad. Sci. [Paris]* **234**, 1870-3 (May 5, 1952) In French.

To verify theoretical relations for the scattering of light by molecules of a length of the same order as the wavelength, experiments are carried out on a suspension of tobacco mosaic virus which consists of long rigid particles. Values are found for the anisotropy factor and the relative values of the components of the vector of scattered light. The agreement with theoretically predicted values lies within experimental errors. A. J. TAYLOR

535.543 : 531.715.1

Birefringent stepgauge. See Abstr. 6306

535.55

6440. Strain patterns in toughened glass. J. M. NAISH AND E. R. WEBB. Letter in *Proc. Phys. Soc. [Lond.] B*, **65**, 457 (June, 1952).

With angles of incidence $> 70^\circ$ and plane polarized light, the strain patterns of a toughened glass sheet can be seen without the usual analyser. The sheet acts as its own analyser and the effect can be enhanced by the presence of a parallel unstrained sheet. R. O. DAVIES

535.55

6441. A castable polyester resin for photoelastic work. B. SUGARMAN, G. O. MOXLEY AND I. A. MARSHALL. *Brit. J. Appl. Phys.*, **3**, 233-7 (July, 1952).

Photoelasticity has, until the last few years, been, in the main, restricted to two-dimensional examination because of the limitations of model-making materials. Requirements for three-dimensional model-making plastics are discussed in detail, and the faults of the few materials used to date listed. The introduction of a cross-linked polyester resin, readily available, into this field permits further investigations to be conducted. The chemical and physical properties of this new resin are considered, and a theory explaining the "frozen" effect propounded. The resin is castable in the user's laboratory, and provided adequate care is taken, castings can be obtained to the near finished size. Mottle, which, it is thought, is developed during the setting period of the resin, and edge effects which appear during the freezing cycle, are the main limitations of this new plastic. Methods of overcoming

both these defects have been devised and the techniques adopted are described in detail. The results indicate that the figure of merit (a criterion which may be adopted as an indication of the sensitivity of the material) of this particular resin is only slightly lower than that of the latest American material, Fosterite. A.

535.61 : 612.843.32

Study of the conspicuity of orange surface colors. See Abstr. 6960

535.64

6442. Object-color changes from daylight to incandescent filament illumination. H. HELSON, D. B. JUDD AND M. H. WARREN. *Illum. Engng* [N.Y.] 47, 221-33 (April, 1952).

Describes an extensive investigation of the changes of colour appearance of a number of different colour samples when viewed under daylight and tungsten lamp light, actually C.I.E. standard illuminants C and A respectively. Various sets of viewing conditions were used. A number of theories of colour adaptation are discussed and predictions based on them are compared with the results obtained experimentally. Some degree of general agreement is found with the theory that adaptation to light of a particular colour alters the relative values of the three primaries for the observer. The authors find that the effect of a given adaptation is very different for different observers.

J. W. T. WALSH

535.65 : 537.312.5

6443. The universal photoelectric colorimeter VEL. D. A. SHKLOVER AND R. S. IOFFE. *Izv. Akad. Nauk SSSR, Otdel Tekh. Nauk*, No. 5, 667-81 (1951) In Russian.

Describes the theoretical principles and construction of a new colorimeter designed by the authors. Light from the standard (or tested) light source (up to 300 W) passes through light filters and enters a photometer headpiece containing a Se photoelement and 2 rotatable disks with light-filter windows. One of these disks enables 3 special light-filter combinations to be inserted in front of the photoelement for determining the colour components X' , Y' , Z' ; the other disk contains 3 filters (red, blue, green) for measuring the colour temperature of incandescent lamps by the red/blue ratio method, and for checking the accuracy of work. Se photoelements used were prepared by the State Optical Institute's method and are claimed to have excellent characteristics. Glass filters (coloured with metal oxides and sulphides) were used, and a CeO_2 filter absorbed ultra-violet radiation. The measurement consisted in taking the reading of the Multiflex galvanometer (sensitivity 5×10^{-9} amp/mm) for an appropriate set of filters, and in evaluating the magnitudes sought by means of previously derived calibration equations. The mutual arrangement of various parts of the apparatus on the optical bench is shown diagrammatically for the measurement of the light and colour characteristics of (1) light sources, (2) materials with "directional" (perfect) transmission, (3) material with diffuse transmission, and (4) materials with diffuse reflection, and luminophores. A nomograph is included for facilitating the calculation. It is claimed that the colorimeter gives more accurate

results than the best visual colorimeters available, even when mean values are taken from results by several observers. The calibration curve shows that a 1% variation in the photocurrent corresponds to a colour temperature change of c. $5-10^\circ(\text{K})$. It follows from the nomograph that 1% changes in the photocurrent ratios (ratios of photocurrents obtained with different filters) correspond to c. 0.2-0.5 of the colour discrimination threshold value.

F. LACHMANN

535.7 : 612.844

Physiological optics. See Abstr. 6958-62

535.822 : 535.244

6444. Schwarzschild-Villiger effect in microspectrophotometry. H. NAORA. *Science*, 115, 248-9 (Feb. 29, 1952).

With a uniform flux of light in the object plane, the ratios (θ) of flare intensity (due to multiple reflections in the microscope) to total intensity in the image plane are tabulated for different numbers (n) of reflecting surfaces and for reflectivities (r) of 5% and 1%. For $n = 13$, $r = 5\%$, $\theta = 13\%$; so that for such a system a small specimen, transmitting 1% and surrounded by a large transparent illuminated area, would have an apparent transmission of 14%. Measurements show a transmission increasing from 1% to 20% as the illuminated area is increased beyond the specimen. The additional flare over that calculated is attributed to scatter at imperfections in the optics. Blooming the surfaces should give great improvement; e.g., $n = 13$, $r = 1\%$ gives $\theta = 0.72\%$.

G. F. LOTHIAN

535.822.9

6445. Reflecting microscope objectives with non-spherical mirrors. S. MIYATAS, S. YANAGAWA AND M. NOMA. Letter in *J. Opt. Soc. Amer.*, 42, 431-2 (June, 1952).

Describes an experimental method of evaporating zinc sulphide onto a spherical mirror, using a series of circular apertures, which are withdrawn at suitable intervals so as to produce a layer of varying thickness, i.e. a non-spherical surface. These surfaces, used as microscope objectives, enable high-magnification photographs to be taken without coma or curvature of the field.

N. CORCORAN

535.823.5

6446. A simple hot stage for the study of polarizing microscope interference figures at elevated temperatures. E. G. STEWARD. *J. Sci. Instrum.*, 29, 214 (July, 1952).

A crystal under examination remains fully accessible, and with a negligible loss of heat in operation cooling arrangements are unnecessary. Temperature may be measured by means of a thermocouple. An example of performance is given.

A.

535.87 : 621.34 : 621.316.718

6447. High-constant-speed rotating mirror. J. W. BEAMS, E. C. SMITH AND J. M. WATKINS. *J. Soc. Mot. Pict. Televis. Engrs*, 58, 159-68 (Feb., 1952).

In many problems, where it is necessary to study accurately phenomena which occur in very short intervals of time, it is desirable to have a high-constant-speed rotating mirror. In the rotating mirror arrangement described in this paper, the total frictional torque is very small with the result that the

speed can be made extremely constant, and hunting, if present, is too small to be observable. The rotating mirror is magnetically suspended in a high vacuum and spun by a rotating magnetic field. The mirror is accelerated to full speed in a way similar to that of the armature in an induction motor, but at running speed it performs as an armature of a synchronous motor. The frequency of the rotating field is determined by a piezoelectrically controlled circuit. Also it is free of hunting. The maximum rotational speed of the mirror is determined only by the strength of the mirror. Mirrors are described which rotate at 20 000 r.p.s. A.

HEAT 536

536.2 : 538.3 : 621.3.012.8

6448. The electrical analogy for the representation of thermal fields. B. DEL NUNZIO AND L. MATTAROLO. *R.C. 51 Rium. Ass. Elettrotec. Ital.* 1950, Fasc. 2, 203-9 (Paper 136, 1951) In Italian.

The basis of the method of representing problems involving thermal flow by a corresponding electrical network, in which difference in temperature is replaced by difference in potential, thermal resistance by electrical resistance, etc., is outlined in some detail, both for stationary states and for the general case. Its application in various industrial processes is indicated. S. WEINTROUB

536.21

6449. Thermal conductivity of germanium. A. GRIECO AND H. C. MONTGOMERY. Letter in *Phys. Rev.*, **86**, 570 (May 15, 1952).

The conductivity of high-purity Ge, cut from a single crystal, along a 100 axis, was found, from the relative temp. drops along the Ge and along rods of Ni and Zn placed thermally in series. Values of 0.14 cal/sec cm °C at 25°C, and about 20% less at 100°C were obtained with an estimated accuracy of ±100%. W. C. MOSS

536.21 : 536.48

6450. The thermal conductivity of metals at low temperatures. I. The elements of groups 1, 2 and 3. K. MENDELSSOHN AND H. M. ROSENBERG. *Proc. Phys. Soc. [Lond.] A*, **65**, 385-8 (June, 1952).

The thermal conductivity of Cu, Ag, Au, Mg, Cd, Al, In and one polycrystalline and two single crystal specimens of Zn have been measured in the range 2-40°K. Each specimen shows a maximum in the conductivity in this range. The values of the coefficients α and β in the equation for the thermal resistance $R = \alpha T^2 + \beta/T$ have been calculated for each specimen. A.

536.21 : 536.48

6451. The thermal conductivity of metals at low temperatures. II. The transition elements. K. MENDELSSOHN AND H. M. ROSENBERG. *Proc. Phys. Soc. [Lond.] A*, **65**, 388-94 (June, 1952).

The thermal conductivity in the range 2-40°K has been measured for Ti, Mn, Fe, Ni, Zr, Cb, Mo, Rh, Pd, Ta, W, Ir, Pt, U and for a Pb single crystal. As a rule, the metals of group 8 have a much higher conductivity than have the metals of the earlier groups.

The values of α and β in the equation for the thermal resistance $R = \alpha T^2 + \beta/T$ have been calculated for each specimen. The experiments on Cb indicate that the normal state was not reached in a field of 3300 gauss at temperatures below 5°K. A.

536.21 : 537.311.31 : 539.27

Thermal and electrical conductivity of porous metals made by powder metallurgy methods. See Abstr. 6792

536.21 : 537.312.62

6452. Heat transport in lead-bismuth alloys. J. L. OLSEN. *Proc. Phys. Soc. [Lond.] A*, **65**, 518-32 (July, 1952).

The variation with temperature and with magnetic field of the heat conductivity of a series of lead-bismuth alloys has been measured. As the concentration of bismuth is increased the heat conductivity in the normal state falls below that in the superconducting state, contrary to the case in pure superconductors. Estimates have been made from the experimental data of the processes contributing to the heat conductivity, and of the resistances due to the various scattering mechanisms limiting these conductivities. A.

536.21 : 551.1

6453. The thermal conductivity of moist soil. A. S. MICKLEY. *Trans Amer. Inst. Elect. Engrs*, **70**, 1789-97 (Pt II, 1951).

A formula is derived for the thermal conductivity in terms of the thermal conductivities and proportions of the air, soil and water, the three components of moist soil. Results of measurements, using the method of Shannon and Wells (1947), on a number of soil samples, and the results of other investigators, are compared with values calculated from the formula. The samples included clay-loam soils, sand and cinders. Field tests were made using a cast bronze 8-in sphere buried to a depth of 4 ft. A constant heat input was placed in the sphere and the resulting temperature rise measured. The effects of moisture migration are discussed. A sample problem on the application of the formula and results to a 6 in buried cable pipe line dissipating 25 W/ft average is given in an appendix. In the discussion, M. S. Kersten refers to empirical results obtained at Minnesota and shows graphically that there is close similarity in form and general agreement with the author's theoretical considerations. W. Parkerson analyses the differences between Smith's (1942) and the author's theories. S. WEINTROUB

536.21 : 612

6454. Conduction of heat in tissue supplied with blood. J. C. JAEGER. *Brit. J. Appl. Phys.*, **42**, 221-2 (July, 1952).

A linear partial differential equation is suggested as a crude approximation to the equation of conduction of heat in tissue supplied with blood. Solutions of some simple cases are given and compared with experimental results. A.

536.23 : 533.7

6455. Conduction of heat in a monatomic gas. J. R. COTTER. *Proc. Roy. Irish Acad. A*, **55**, 1-28 (No. 1, March, 1952).

The kinetic theory is used to calculate the numerical

value of the conductivity of a gas, making use of the direct solution of a restricted form of Boltzmann's integral equation. It is necessary to consider the gas to be in a specially chosen state so as to restrict the velocity distribution function, and the molecules are assumed to be hard and perfectly smooth and elastic. An exact solution is obtained which has the advantage over the usual method of successive approximation of making possible the complete solution of the second order equation which may lead to further advances in the subject. The paper is entirely mathematical.

W. C. MOSS

536.25 : 538.65 : 523.877

6456. On the inhibition of convection by a magnetic field. S. CHANDRASEKHAR. *Phil. Mag.*, **43**, 501–32 (May, 1952).

In this paper the theory of the stability of a layer of fluid heated below, which has been developed by Rayleigh, Jeffreys, Pellew and Southwell, is extended to the case when the fluid considered is an electrical conductor and an external magnetic field is impressed on the fluid. The problem is first investigated on the assumption that the principle of the exchange of stabilities (i.e. the equations governing marginal stability are those which are obtained from the general time-dependent equations by setting $\partial/\partial t = 0$), is valid. A differential equation of order 6 for the normal component of the velocity is derived. Suitable boundary conditions are formulated; they depend on whether the bounding surfaces are free or rigid. The case when the magnetic field and gravity act in the same direction is investigated in some detail. A variational procedure for solving the relevant equation satisfying the necessary boundary conditions and determining the critical Rayleigh numbers for the onset of convection are described. Tables of the critical Rayleigh numbers are provided for the three cases (i) both bounding surfaces free, (ii) both bounding surfaces rigid, and (iii) one bounding surface free and the other rigid. Finally, the principle of the exchange of stabilities is examined and it is shown that it is valid if $4\pi\mu\sigma\kappa < 1$, where μ is the magnetic permeability, σ the electrical conductivity and κ the thermometric conductivity. This condition is satisfied under most terrestrial conditions; but under astrophysical conditions it is not. In the latter case, it is shown that instability can arise either as cellular convection or as over-stability (i.e. by oscillations of increasing amplitude) depending on the magnitude of the velocity of the magneto-hydrodynamic wave $[(\mu H^2/4\pi\rho)^{1/2}]$.

A.

536.251 : 539.62

6457. Frictional heat calculated as a phenomenon of solid convection. P. VERNOTTE. *C.R. Acad. Sci. [Paris]* **234**, 1751–3 (April 28, 1952) *In French*.

A study is made of the frictional heat developed in the skids of a flying machine on landing, to see under what conditions the heat is sufficiently rapidly absorbed into the ground to prevent overheating of the skids. It is shown that by assuming the ground to be moving past a stationary skid, an effect equivalent to heat loss by convection is produced. Taking the extreme case by neglecting conduction in the skid itself and its thermal capacity and assuming perfect contact with the ground, it is shown that to avoid a

high temp., the skids should be short, wide and of considerable thermal capacity.

W. C. MOSS

536.41

6458. Low temperature thermal expansion of uranium. A. F. SCHUCH AND H. L. LAQUER. Letter in *Phys. Rev.*, **86**, 803 (June 1, 1952).

The expansion of uranium has been measured at temperatures below 0°C using a dial gauge dilatometer. It is found that the expansion coefficient changes sign between 60°K and 20°K. It is considered that this corresponds to a density maximum due to anisotropy.

F. E. HOARE

536.423.15 : 536.44

6459. The vapor pressures and critical constants of pure ozone. A. C. JENKINS AND C. M. BIRDSALL. *J. Chem. Phys.*, **20**, 1158–61 (July, 1952).

Vapour pressures of pure ozone have been measured over the range –183°C to –30°C with an estimated accuracy of $\pm 3\%$ and are represented by the equation $\log P_{mm} = 8.25313 - (814.941587/T) - 0.0019669437T$. The normal boiling point is $-111.9^\circ\text{C} \pm 0.3^\circ\text{C}$. The critical temperature has been determined experimentally and found to be $-12.1^\circ\text{C} \pm 0.1^\circ\text{C}$. The critical pressure derived from this critical temperature and the vapour pressure equation is 54.6 atm. absolute. Results are, in general, in good agreement with the meagre data in the literature. The precision of the vapour pressure data is limited by the unstable nature of ozone and the necessarily small samples which must be used for measurements in the interests of safety.

A.

536.423.4

6460. Number of drops formed on condensation, and the time taken for their formation. R. B. SEGAL. *Zh. Eksper. Teor. Fiz.*, **21**, 814–20 (No. 7, 1951) *In Russian*.

With the help of the Zeldovitch formula for the stationary "current" of drops generated in supersaturated steam, the number of such drops arising at complete condensation is found and also the time of their formation in the case of absence of a nucleus of condensation. The results of calculation are compared with those obtained in operation of Wilson chambers.

N. GULLILAND

536.424

6461. Geometrical representation of thermal transitions of higher order. A. R. UBELLOHDE. Letter in *Nature [Lond.]* **169**, 832 (May 17, 1952).

It is suggested that the free-energy surfaces do not make, in reality, true geometrical intersection or contact at the transition point, but exhibit an "indeterminacy thickening" in the transition region, the origin of which can vary according to the atomic framework of the system.

F. LACHMAN

536.424

6462. The nature of the gradual transition in NH_4Cl and ND_4Cl . C. C. STEPHENSON, R. W. BLUE AND J. W. STOUT. Letter in *J. Chem. Phys.*, **20**, 1046–7 (June, 1952).

The heat capacities of NH_4Cl and ND_4Cl in the temperature interval 20–300°K have yielded for the entropy change associated with gradual transition values of 1.2–1.5 cal deg⁻¹ mole⁻¹, thus agreeing with the value $R \times \ln 2 = 1.36$ derived for the order-disorder nature of the transition.

F. LACHMAN

536.424 : 539.234

6463. On thermal changes in thin films of gold and A. Féry's transformation points. A. COLOMBANI AND G. RANC. *C.R. Acad. Sci. [Paris]* **234**, 1757-9 (April 28, 1952) *In French*.

Thin films of gold, vacuum-evaporated on to silica slides, were examined by means of resistance measurements at various temperatures so as to observe any changes in the crystal structure of the kind observed by Féry for films of Pt black. It is considered incorrect to refer in detail to points of transformation associated with progressive crystallization in stages, but that the sudden changes in resistance observed may be due to outgassing of the film in bursts.

C. A. HOGARTH

536.44

6464. On the liquid-vapor coexistence curve of xenon in the region of the critical temperature. M. A. WEINBERGER AND W. G. SCHNEIDER. *Canad. J. Chem.*, **30**, 422-37 (May, 1952).

The curves of very pure xenon have been determined in bombs of vertical lengths 1.2 and 19 cm. The longer bomb yielded a flat-topped curve, the shorter a more rounded curve. The classical Van der Waals theory is capable of explaining a large portion of the flat top if effects of gravity are taken into account. Details of the theoretical variation of the width of the flat top with vertical bomb lengths are given. The critical data obtained for xenon are $\rho_c = 1.105 \text{ g/cm}^3$, $T_c = 16.590 \pm .001^\circ\text{C}$. The danger of contamination of gases in the critical region on contact with gasket or packing materials is stressed.

A.

536.461

6465. Polyhedral flames with hydrogen and hydrocarbons. H. BROIDA AND W. KANE. Letter in *J. Chem. Phys.*, **20**, 1042-3 (June, 1952).

Polyhedral flames were observed in premixed $\text{H}_2\text{-O}_2$ -diluent mixtures containing 60-80% diluent; He , A and N_2 were used as diluents. In flames diluted with He , polyhedral flames were difficult to obtain, occurring only with greater amounts of diluent and leaner mixtures. In propane flames, polyhedral structures appeared only in fuel-rich mixtures, and were not obtainable when He was used as diluent. No polyhedral structure was observed in acetylene flames. These results are consistent with the hypothesis that polyhedral structure is caused by localized changes in mixture composition arising from differential diffusion of the constituents.

A. SCHOFIELD

536.461

6466. Nonisotropic propagation of combustion waves. G. H. MARKSTEIN. Letter in *J. Chem. Phys.*, **20**, 1051-2 (June, 1952).

Manton *et al.* [Abstr. 2676 (1952)] criticized an earlier paper by Markstein (1951) on the grounds that (a) his 1st-order solution is incapable of predicting the amplitude of perturbations; (b) the stabilizing effect of wave-propagation normally outweighs the effect of hydrodynamic instability; (c) according to his theory all combustion waves should be cellular. In reply it is pointed out that (a) the 1st-order solu-

tion is capable of predicting the stability of an initial state of zero amplitude; (b) the stabilizing effect of wave propagation does not compensate a 1st-order hydrodynamic instability; (c) cellular structure should only appear when the size of the apparatus exceeds a certain minimum. It is suggested that present experimental evidence does not rule out the possibility that all flames might become cellular if the combustion vessel were large enough.

A. SCHOFIELD

536.48

6467. Low-temperature physics. G. O. JONES. *Sci. Progr.*, **40**, 23-43 (Jan., 1952). A review.

536.48

6468. Coexistence of liquid helium I and II. P. CLOSMANN AND R. T. SWIM. Letter in *Phys. Rev.*, **86**, 576-7 (May 15, 1952).

This was realized by bringing the top and bottom of a vertical glass tube of 55 cm length into good thermal contact with liquid N_2 and with He II respectively, and filling it with He to a pressure $> 2.2 \text{ atm}$, i.e. above the critical pressure. A thermometer which could be moved along the tube indicated that the He II region extended through practically the whole tube, leaving only 4 cm at the top for the temperature gradient between 2.16° and 80°K .

H. LONDON

536.48

6469. The liquid-solid transformation in helium from 1.6° to 4°K . C. A. SWENSON. *Phys. Rev.*, **86**, 870-5 (June 15, 1952).

The transformation from liquid to solid helium behaves quite differently above and below the intersection of the λ point-pressure curve with the melting pressure curve. The experimental data given here extend previous work from below 1.8° to about 4° , and show the effect of the λ -transformation on the latent heat of melting, the change in molar volume on melting, and the melting pressure curve. When these data are combined with a new determination of the λ point-pressure curve, the indication seems to be that the λ -transformation is not truly of second order; that is, that it does not obey the Ehrenfest equations.

A.

536.48

6470. On the relationships between the Landau and London-Tisza models of liquid helium II. H. N. V. TEMPERLEY. *Proc. Phys. Soc. [Lond.] A*, **65**, 490-511 (July, 1952).

The Landau (1941) picture of liquid helium II as a modified Debye model is critically compared with the London-Tisza picture of liquid helium II as a condensed Bose-Einstein assembly in an attempt to find some common features. Two such common features are found, first that the criterion for Bose-Einstein condensation in a one-particle model is $(\partial S/\partial N)_{E,V} \leq 0$ or $g = (\partial F/\partial N)_{V,T} \geq 0$, a condition that can also be satisfied by a Debye model below a certain temperature. Secondly, an assembly satisfying such a condition is in principle capable of being in thermodynamic equilibrium with a weakly adsorbed film or with free atoms of small energy. It is also suggested that such atoms may make possible the observed phenomena of superfluid flow because their

wave-functions are abnormally sensitive to small applied external fields of force, and some evidence in support of this is presented. A numerical study of the Landau-Debye model shows that, in accordance with observed facts on helium II, its energy spectrum is probably modified considerably in channels of less than 10^{-4} cm width. It is also concluded that the Debye model is probably not a workable approximation near the λ -point, but that it is correct at sufficiently low temperatures. A.

536.48

6471. The thermal conductivity of liquid helium I. R. BOWERS. *Proc. Phys. Soc. [Lond.] A*, **65**, 511-18 (July, 1952).

The thermal conductivity of liquid helium has been measured between 2.2 and 4°K. It is found to increase with temperature over the whole range and shows no sign of anomalous behaviour just above the λ -point. This variation is compared with that of the viscosity and entropy in the same temperature range. A.

536.48 : 530.162

6472. Further considerations regarding the theory of Bose-Einstein liquids. J. G. DAUNT, T. P. TSENG AND C. V. HEER. *Phys. Rev.*, **86**, 911-14 (June 15, 1952).

Model solutions of non-degenerate Fermi-Dirac systems in Bose-Einstein liquids, as proposed previously by Heer and Daunt, are discussed. A discussion is given of the physical basis for the excess partial vapour pressure of the F-D component, which is shown to be due to the degeneracy of the B-E liquid. The theory is applied to solutions of He³ in liquid He⁴, and a tentative explanation is given for the empirical hypothesis proposed by Taconis in accounting for the observed partial vapour pressures of such solutions. The results of computations of the distribution coefficient C_v/C_L and the total vapour pressure for strong solutions of He³ in liquid He⁴ are presented, these computations having been made using (a) the laws for perfect classical solutions, (b) the theory of Heer and Daunt, and (c) the theory of de Boer and Gorter. A comparison with the experimental values of C_v/C_L and of total vapour pressures for strong solutions is given, and it is deduced that the Heer and Daunt model of a quantum solution is in good agreement with the observations at temperatures below about 1.8°K and that above this temperature the model gives qualitatively the correct trend but that owing to vapour imperfections exact numerical agreement cannot be expected. A.

536.531

6473. The pressure coefficient of resistance of thermistors. A. D. MISENER AND L. G. D. THOMPSON. *Canad. J. Techn.*, **30**, 89-94 (April, 1952).

To assess the suitability of thermistor thermometer elements for measurement under considerable pressure, the pressure coefficient of resistance for one type was determined up to pressures of 2000 lb. per in² at temperatures of 0°, 25° and 50°C. The pressure coefficient at any given pressure appeared to be independent of temperature, but changed rapidly with pressure, decreasing with increased pressure from

— 3.0×10^{-6} per lb. per in², at atmospheric pressure to — 1.5×10^{-6} per lb. per in² at 1000 lb. per in², and approaching a zero value at 2000 lb. per in². For temperature measurements less accurate than $\pm 0.1^\circ\text{C}$ the effect of pressure was negligible. For temperature measurements accurate to $\pm 0.1^\circ\text{C}$ the effect of pressure was noticeable, but the error introduced was less than the error in temperature measurement except for temperatures near 0°C. More accurate temperature readings taken under even moderate pressures would need to be corrected for the effect of pressure. A.

536.531 : 531.508.29

Performance characteristics of Sanborn rod thermistors. See Abstr. 6921

536.532

6474. A recording device for surface temperature measurements. N. SASAKI AND A. KAMADA. *Rev. Sci. Instrum.*, **23**, 261-3 (June, 1952).

By means of a small heating coil, the temperature of a thermocouple junction is made to oscillate regularly between two temperatures T_1 and T_2 . Simultaneously the junction makes about one contact every two seconds with the surface being measured. A short-period galvanometer in the thermocouple circuit produces on a moving photographic film a serrated sine curve whose serrations vanish once for every half-oscillation at a point that corresponds to the surface temperature T_s , provided T_s lies between T_1 and T_2 . This mode of measurement minimizes disturbances due to air currents. Alternatively, use of a thermocouple with two adjacent junctions is proposed. A simple but accurate portable thermostat for maintaining reference junctions at temperatures somewhat higher than room temperature is also described. A.

536.587 : 553.1 : 545 : 621.389

6475. An improved apparatus for the differential thermal analysis of minerals. J. J. THERON. *Brit. J. Appl. Phys.*, **3**, 216-20 (July, 1952).

The electronics of the proportioning temperature control is described and circuit diagrams and an indication of the performance of the control and differential amplifiers are given. A.

536.622

6476. The calorimetry of non-isothermal bodies. P. VERNOTTE. *C.R. Acad. Sci. [Paris]* **234**, 1855-65 (May 5, 1952) In French.

A theoretical study of the calorimetry of a body plunged into mercury in a Dewar flask, considering that the heat flux at its maximum would maintain a temperature difference of about 2° between the surface and the bottom of the mercury, and that the temperature gradient is not linear. It is shown that the heat exchange coeff. can be determined to within a few per cent from a single temp. measurement at a depth $H/\sqrt{3}$, where H is the total depth of the mercury. W. C. MOSS

536.631

6477. Specific heat of germanium between 20°K and 200°K. I. ESTERMANN AND J. R. WEERTMAN. *J. Chem. Phys.*, **20**, 972-6 (June, 1952).

Three samples were investigated: extremely pure,

intermediate purity (10^{18} impurity centres/cm³) and one with an addition of 0.006 atomic % (2×10^{20} impurity centres/cm³). No anomaly such as reported by Cristescu and Simon was found in any of the samples. However, a small dependence of the specific heat on the concentration of impurity centres was observed.

A.

536.631 : 548.0

6478. The specific heat of barium titanate between 100°K and 410°K. J. VOLGER. *Philips Res. Rep.*, **7**, 21-7 (Feb., 1952).

The specific heat of polycrystalline BaTiO₃ was measured in a Nernst calorimeter. The lattice contribution cannot be described accurately with a single Debye function. In three transition regions the anomalous peaks in the specific heat were determined.

A.

THERMODYNAMICS 536.7/8

536.71

6479. Equation of state computations. J. E. MAYER AND G. CARERI. *J. Chem. Phys.*, **20**, 1001-13 (June, 1952).

A logical computation method is suggested for approximating the thermodynamic properties of a simple molecular system. In this method the thermodynamic functions of a non-equilibrium system are computed exactly. The state of the system is then varied at fixed volume and temperature so as to give a minimum Helmholtz free energy, consistent with such conditions as are imposed to permit the exact computations. The condition under which this method leads to self-consistent equations is discussed. The method is then applied in a way that is very close to the Lennard-Jones and Devonshire cell method, but with cells of variable size. The distribution within a cell is assumed to be Gaussian. The method is numerically far easier than the cell method, and apparently somewhat better.

A.

ELECTRICITY 537

537.081.3/4 : 621.3.081

6480. Units and standards of measurement employed at the National Physical Laboratory. III. Electricity: current, voltage, resistance, power, energy, inductance, capacitance, frequency, etc. *Department of Scientific and Industrial Research, London, H.M. Stationery Office* (1952) 14 pp.

This pamphlet gives an account of (a) the units employed at the National Physical Laboratory for the measurement of electrical quantities and (b) the standards by means of which these units are determined and preserved, and made applicable to the various techniques of modern practice, such as d.c., a.c. and radio-frequency work. The outstanding events in the history of the subject, the relevant international agreements and the legal position are all briefly reviewed.

THEORY . ELECTRONS 537.1

537.12 : 530.162

6481. A collective description of electron interactions. R. KRONIG. Letter in *Phys. Rev.*, **86**, 795 (June 1, 1952).

Points out that papers by Bohm and Pines [Abstr. 5379 (1951), 2688 (1952) contain ideas originally propounded by Kronig and Korringa [Abstr. 1891 (1945)].

C. A. HOGARTH

ELECTROSTATICS . DIELECTRICS 537.2

537.212 : 539.13

6482. Determination of a single quadrupole for a charge distribution. E. S. CAMPBELL. *J. Chem. Phys.*, **20**, 666-7 (April, 1952).

A method is given for the reduction to a single quadrupole of the 2nd-order term in the Taylor series expansion of the potential defined by a charge distribution.

A.

537.226.2

6483. The dielectric properties of compressed fluoromethane. H. G. DAVID, S. D. HAMANN AND J. F. PEARSE. *J. Chem. Phys.*, **20**, 969-71 (June, 1952).

The dielectric constant, dielectric loss, and density of compressed fluoromethane were measured at 50°C and 75°C in the pressure range 20 to 160 atm. The ratio $(\epsilon - 1)/d(\epsilon + 2)$ shows a large and regular decrease as the density increases. The theories of Debye, Onsager and Kirkwood were applied to the results. Evidence of the restriction of molecular rotation at high densities is adduced.

A.

537.226.2

6484. The dielectric constants of binary mixtures. J. W. TOMECKO AND W. H. HATCHER. *Trans Roy. Soc. Can., Sect. III*, **45**, 39-51 (June, 1951).

Measurements of dielectric constants of non-aqueous solutions using a method in which the effect of leakage conductance is minimized. Results for pure liquids agree with those of previous workers and the work on polarization of binary mixtures gives information comparable to the Raman spectrum results.

T. C. TOYE

537.226.2

6485. A ferroelectric ammonium metaphosphate. R. PEPINSKY, C. M. MCCARTY, E. ZEEMAN AND K. DRENCK. Letter in *Phys. Rev.*, **86**, 793 (June 1, 1952).

Suitably prepared ammonium phosphate is ferroelectric in the temperature range -193° to 38°C. Above 38°C the ferroelectric effects are obscured by large conductivity, but the dielectric constant is rising rapidly at this temperature.

G. F. J. GARLICK

537.226.2

6486. An analysis of the pressure dependence of the dielectric constant of polar liquids. I. S. JACOBS AND A. W. LAWSON. *J. Chem. Phys.*, **20**, 1161-4 (July, 1952).

The Onsager and Kirkwood theories of polar liquids have been used to analyse the available

experimental data on the pressure dependence of the dielectric constant. It is found necessary in most cases to assume an appreciable decrease in the dipole moment arising from intramolecular distortion which may be large enough in some cases to more than compensate for the increase in effective moment caused by intermolecular compression. Quantitative estimates of these two factors are given, and their influence on binding energy and compressibility is discussed. A.

537.226.2 : 537.228.1

6487. On the variation of the h.f. dielectric constant of quartz with temperature between 20°C and 700°C; the α - β transformation; thermal twinning and mechanical de-twinning. J.-P. PÉREZ. *Ann. Phys. [Paris]* 7, 238-82 (March-April, 1952) In French.

Quartz plates, cut normal to the X, Y or Z axis and having deposited Pt or Au electrodes, formed part of the C of a simple L-C oscillator of about 1 Mc/s frequency, which was compared with that of a conventional quartz-stabilized oscillator. With temperature rising through the α - β transformation at about 570°C most X and Y plates showed a discontinuous drop in permittivity nearly equal to that inferred from the optical refractive index drop. The Z plates could not be tested in this temp. region since high Z-axis conductivity caused spurious frequency variation. Optical, etch and X-ray test results are given for specimens taken up and down through 570°C, and for specimens de-twinning by mechanical straining (torsion). The piezo-electric resonance frequency may be observed continuously during the latter process. Some theoretical discussion is included.

F. F. ROBERTS

537.226.2 : 538.569

6488. Dielectric dispersion in pure polar liquids at very high radio-frequencies. I. Measurements on water, methyl and ethyl alcohols. J. A. LANE AND J. A. SAXTON. *Proc. Roy. Soc. A*, 213, 400-8 (July 8, 1952).

The results are given of some measurements of the absorption coefficient and refractive index of water, methyl and ethyl alcohols at wavelengths of 6.2 mm, 1.24 cm and 3.21 cm over the temperature range -10 to 50°C, including some observations on water in the supercooled state. The method used is based upon the fact that the rate of attenuation of r.f. energy along a wave-guide filled with the liquid is dependent upon both the absorption coefficient and the refractive index when the guide is operated near to the cut-off condition. The electrical characteristics of water vary in a continuous manner through the normal freezing-point of 0°C down to at least -8°C. The measurements indicate that both alcohols, like water, have relatively high atomic polarizations. A.

537.226.2 : 538.569

6489. Dielectric dispersion in pure polar liquids at very high radio-frequencies. II. Relation of experimental results to theory. J. A. SAXTON. *Proc. Roy. Soc. A*, 213, 473-92 (July 22, 1952).

The results of Pt I are analysed. There is no evidence that, for any of these liquids, more than a single relaxation time as a function of temperature is required to account for the dispersion arising from dipole rotation. It is suggested that the observed

behaviour of the two alcohols at wavelengths near to 1 cm, which appears not to conform with the hypothesis of a single relaxation time, is in fact the consequence of resonance absorption. If it is supposed that in dipole rotation and viscous flow the molecules have to surmount potential energy barriers, then it appears that, in each of the liquids examined, the heights of the barriers concerned in the two processes are identical; but the "frequency factor" associated with such processes is much larger for viscous flow than for dipole rotation. A.

537.226.2 : 538.569.3

6490. The dielectric estimation of protein hydration. T. J. BUCHANAN, G. H. HAGGIS, J. B. HASTED AND B. G. ROBINSON. *Proc. Roy. Soc. A*, 213, 379-91 (July 8, 1952).

Microwave dielectric measurements on six aqueous protein solutions are analysed in terms of water "irrotationally bound" to the protein, i.e. unable to rotate in the high-frequency field. Estimates are made of the maximum amount of bound water, i.e. water carried through the solution with the protein, as a function of axial ratio, assuming a spheroid molecule. Taking hydration estimates in conjunction with other data, it is concluded *inter alia* (1) That the β -lactoglobulin and egg-albumin molecules approximate to prolate rather than to oblate spheroids. (2) That a large proportion of the charged groups in horse methaemoglobin "protrude" from the surface of the molecule. A.

537.226.2 : 539.133

6491. On the reaction field and dielectric constant of polar liquids. D. G. FROOD AND A. J. DEKKER. *J. Chem. Phys.*, 20, 1030-3 (June, 1952).

It is shown that Onsager's formula for the dielectric constant of liquids, derived on the assumption of spherical molecules and a central mathematical dipole, still holds for extended dipoles of arbitrary position and direction as long as the molecules are spherical in shape. A.

537.226.2 : 539.213.1

6492. A study of the electrical properties of alkali-lime-silica glasses, some containing boric oxide or alumina, in relation to glass structure. H. MOORE AND R. C. DE SILVA. *J. Soc. Glass Techn.*, 36, T5-T55 (Feb., 1952).

A theoretical survey is made of the electrical conductivity, dielectric constant and power factors of glasses in relation to composition and structure. This is followed by a description of experimental observations of these and related properties on five series of glasses, and the experimental results are discussed in relation to the theoretical treatment. Conclusions of an essentially qualitative character are drawn relating to the movement of the alkali ions through glasses and also to the structure of glasses. Certain of these are already well established as the result of earlier work on the electrical properties of glasses; the others support conclusions based on other evidence. (1) The alkali ions within the smaller interstices are held comparatively strongly, but with increasing alkali content the ions are distributed increasingly among the larger interstices where they are less strongly held. (2) The atoms of the divalent

metals are strongly held as part of the glass structure; they enlarge the interstices and reduce the forces exerted on the alkali ions, thus facilitating the migration of these ions. (3) Alumina replacing silica causes the structural rings to be enlarged, thus loosening the structure and facilitating ionic migration. (4) Boric oxide replacing silica reduces the size of the structural rings, tightening the structure and rendering ionic migration more difficult. (5) Sodium ions are held less strongly than potassium ions in structural rings of similar type and shape; the forces exerted on sodium ions within interstices which are too small to house potassium ions are comparatively large, but no evidence has been obtained to indicate whether these forces are larger or smaller than the forces on potassium ions located in the smallest interstices within which they can be housed. A.

537.226.3 : 532.7

6493. Dielectric absorption and anomalous dispersion of polar solutions. K. NUKASAWA. *Monogr. Ser. Res. Inst. Appl. Elect.*, No. 2, 57-69 (1951).

After a short theoretical discussion, experimental results on selected liquids at a wavelength of 10-45 cm are given. A number of conclusions are reached, one being that the rotation of a molecule has a large effect on its neighbours, the relation found between the enthalpy and entropy confirming this. T. C. TOYE

537.226.3

6494. Dielectric dispersion in materials having a distribution of relaxation times. J. R. MACDONALD. *J. Chem. Phys.*, 20, 1107-11 (July, 1952).

On the basis of considerable experimental evidence, a particular form for the dielectric loss factor, ϵ'' , is assumed to hold for many materials exhibiting a distribution of relaxation times. The dielectric constant, ϵ' , corresponding to the assumed form of ϵ'' is then computed by means of the Kronig-Kramers relations and tabulated as a function of log frequency and of the distribution function half-width parameter, α . Using these results, experimental ϵ' and ϵ'' curves can be easily tested for mutual consistency and can be fitted individually. In conclusion, a brief discussion of other methods of dealing with the many-relaxation-time dispersion problems is given. A.

537.228.1 : 621.317.715

6495. A brief note on a piezo-electric vibration galvanometer. H. LAPORTE. *Z. angew. Phys.*, 4, 16-17 (No. 1, 1952) *In German*.

The Rochelle salt vibrator due to Golay [*Rev. Sci. Instrum.*, 8, 228-30 (July, 1937)] is combined with a 3-stage RC-coupled amplifier. Overload protection is provided by a glow discharge lamp connected in parallel with the crystal, and by saturation of the amplifier. Sensitivity is given as 5 $\mu\text{V/div}$. at 50 c/s, input $Z = 50 \Omega$. C. F. PIZZHEY

ELECTRIC CONDUCTION . CURRENTS 537.3

537.311.31 : 536.21 : 539.217

Thermal and electrical conductivity of porous metals made by powder metallurgy methods. See Abstr. 6792

537.311.31 : 539.23

6496. The influence of the electric field on the changes occurring in thin films. M. PERROT AND J.-P. DAVID. *C.R. Acad. Sci. [Paris]* 234, 1753-5 (April 28, 1952) *In French*.

The ageing of very thin Al and Ag films is investigated by measuring resistance changes while the films are maintained at 10^{-6} mm Hg. The resistance after a given time increases more rapidly in the case of the higher electric fields. C. A. HOGARTH

537.311.32

6497. The conductivity of some molten silicates on fayalite basis. G. BJÖRLING. *K. Tekn. Högsk. Handl.*, No. 59, 29 pp. (1952).

The electrical conductivity σ of fayalite [$2\text{FeO} \cdot \text{SiO}_2$] was measured from about 13-1400°C down to the temperature of crystallization. Pt electrodes were used but a potential probe method of measurement was not employed. Various additives, mainly silicates and oxides, sulphides of the heavy metals and fluorspar, were used. The conduction mechanism assumes that only cations are mobile. The greater the content of metals with small ionic radius ($< 0.8 \text{ \AA}$) the larger is σ ; increasing content of SiO_4^{4-} ions decreases σ . The sulphide ions give little increase in σ . The temperature variation follows the law $\log \sigma = -A/T + B$. A is related to the energy required to move an ion and is large for small values of σ . B lies between 1.5 and 3. As supercooling often occurs these measurements are not suitable for the estimation of phase diagrams, but they do help to provide data for the optimum conditions of operation of electric furnaces for metal extraction, where the silicate mixture acts as the resistive heating element. C. A. HOGARTH

537.311.33

6498. Electric properties of thin foils containing grey tin. N. A. GORYUNOVA, I. D. KONOZENKO AND A. P. OBUKHOV. *Zh. Tekh. Fiz.*, 21, 814-17 (No. 7, 1951) *In Russian*.

Based on sublimation in vacuum, a method of obtaining thin layers of tin on a cooled surface, primed with grey tin, is described. These layers consisting of mixed grey and white tin have properties widely different from white tin layers of the same thickness. Specific resistance varies between 10^3 and 10^4 ohm-cm. Such layers have negative temperature coefficient of resistivity of the order of 3-5%/°C. J. LUKASZEWICZ

537.311.33

6499. The semiconducting properties of cuprous oxide. I. Procedure for preparation allowing for conditions of stability. G. BLANKENBURG AND K. KASSEL. *Ann. Phys. [Lpz.]* 10, 201-10 (No. 4-5, 1952) *In German*.

A method of preparation of Cu_2O crystals of high purity and quality in which Cu is oxidized in the temperature region 1000-1030°C, the resultant mass is tempered in oxygen, and the crystal is allowed to cool down to room temperature in air. The tempering pressures and temperatures are derived from the $\text{Cu/Cu}_2\text{O/CuO}$ phase diagram. C. A. HOGARTH

537.311.33

6500. The semiconducting properties of cuprous oxide. II. The influence of defects on the optical absorption. K. KASSEL. *Ann. Phys. [Lpz.]* 10, 211-16 (No. 4-5, 1952) *In German*.

The absorption of Cu_2O crystals in the ground band peak region (0.638μ) is measured as functions of thickness of crystal and oxygen "tempering" pressure used during the preparation. The absorption decreases with decreasing pressure. At the lowest pressures a rise in the absorption occurs. It is considered that the minimum indicates the tempering condition for the production of stoichiometric Cu_2O .

C. A. HOGARTH

537.311.33

6501. The semiconducting properties of cuprous oxide. III. The dependence of electrical conductivity at low temperatures on the oxygen pressure during the preliminary heat treatment. G. BLANKENBURG, C. FRITZSCHE AND G. SCHUBART. *Ann. Phys. [Lpz.]* 10, 217-31 (No. 4-5, 1952) *In German*.

The law of variation of conductivity with oxygen pressure established by Wagner and his collaborators is only found to hold for specimens prepared in granular form and at a particular temperature. If the conductivity is expressed in terms of the oxygen "tempering" pressure a more complicated variation may be observed and related to the $\text{Cu}/\text{Cu}_2\text{O}/\text{CuO}$ phase diagram and to the optical absorption results.

C. A. HOGARTH

537.311.33

6502. The semiconducting properties of cuprous oxide. IV. Conductivity measurements at high temperatures. O. BÖTTGER. *Ann. Phys. [Lpz.]* 10, 232-40 (No. 4-5, 1952) *In German*.

Conductivity is measured as functions of oxygen pressure and temperature (both ambient) and the results of Dünwald and Wagner (1933) are confirmed within the limits of existence of Cu_2O . As the crystal composition tends to $\text{Cu} + \text{Cu}_2\text{O}$ or $\text{Cu}_2\text{O} + \text{CuO}$, marked deviations occur. The results are discussed in terms of a corpuscular model.

C. A. HOGARTH

537.311.33

6503. The semiconducting properties of cuprous oxide. V. The interpretation of the dependence of the electrical conductivity at low temperatures on the pressure of oxygen during the preparation. G. BLANKENBURG AND O. BÖTTGER. *Ann. Phys. [Lpz.]* 10, 241-52 (No. 4-5, 1952) *In German*.

A general discussion of the mechanism of tempering Cu_2O , of the formation of defects of different activation energy, of the conditions of formation of stoichiometric material, and of the changes in properties observed when the tempering is carried out at high or very low pressures of oxygen.

C. A. HOGARTH

537.311.33

6504. Conductivity and fluctuation effect in very thin films of carbon. N. NIFONTOFF. *C.R. Acad. Sci. [Paris]* 234, 1755-7 (April 28, 1952) *In French*.

The resistance and noise voltage are measured for various thin C films and under various ambient gas conditions as functions of the 6000 c/s current passing.

C. A. HOGARTH

537.311.33

6505. Transference numbers for electrical conduction in glass. J. V. FITZGERALD. Letter in *J. Chem. Phys.*, 20, 922 (May, 1952).

One method of estimating transference numbers is by comparison of (a) measured ionic diffusion coefficients with (b) those calculated from the electrical conductivity. (a) is known to be $\simeq$ (b) for e.g. Pb^{+++} in PbI_2 (assuming the Einstein relation valid) but a comparison of published data with the calculated numbers for the diffusion of Na ions in certain glasses shows (a)/(b) $\simeq$ 0.3 to 0.5. The additional factor which must be contributing to the conduction process in such cases remains unknown.

A. J. KENNEDY

537.311.33

6506. Electric conduction of thin vacuum-evaporated platinum films deposited on dielectric surfaces. C. FELDMAN. *C.R. Acad. Sci. [Paris]* 234, 1858-60 (May 5, 1952) *In French*.

Results for layers deposited on SiO_2 , KBr and CaF_2 . The resistance depends markedly on the dielectric substrate material, apparently as a result of the formation of films of varying degree of crystallinity.

C. A. HOGARTH

537.311.33

6507. Semiconducting properties of the oxides of iron. J. MARTINET. *C.R. Acad. Sci. [Paris]* 234, 2167-9 (May 26, 1952) *In French*.

Measurements of resistance R as a function of temperature T are described for compressed pellets of $\alpha\text{Fe}_2\text{O}_3$, $\gamma\text{Fe}_2\text{O}_3$, and Fe_3O_4 of high purity. Intermediate materials were also prepared by prolonged oxidation of Fe_3O_4 and these were examined. In the range -190°C to $+100^\circ\text{C}$ the curves relating $\log R$ and $1/T^\circ\text{K}$ are substantially linear but show an anomaly, in the case of Fe_3O_4 at 120°K . This is the same temperature as for a ferromagnetic anomaly previously reported.

C. A. HOGARTH

537.311.33

6508. The parameters of partially degenerate semiconductors. J. S. BLAKEMORE. Letter in *Proc. Phys. Soc. [Lond.] A*, 65, 460-1 (June, 1952).

Approximations to the Fermi-Dirac integral which occurs in the theory of semiconductors are discussed.

P. T. LANDSBERG

537.311.33

6509. Effects of dislocations on mobilities in semiconductors. D. L. DEXTER AND F. SEITZ. *Phys. Rev.* 86, 964-5 (June 15, 1952).

The scattering of electrons or holes in semiconductors by the dilation of the lattice around rigidly randomly-arranged edge-type dislocations is treated by the method of the deformation potential. The contribution of this scattering to the electrical resistance is determined from the Boltzmann transport equation by the method of Mackenzie and Sondheimer, except for the use of Maxwell-Boltzmann rather than Fermi-Dirac statistics. The temperature dependence of the reciprocal of the mobility μ is given by $1/\mu = \alpha_1 T^{-\frac{1}{2}} + \alpha_2 T^{-\frac{3}{2}} + \alpha_3 T^{-1}$ where the α 's are temperature-independent quantities referring to scattering from the lattice, impurity atoms, and

dislocations, respectively. A discussion is given of the relative magnitudes of these three terms, and of the possibility of obtaining experimental information concerning dislocations in semiconductors by electrical measurements. A.

537.311.33 : 538.632

6510. The Hall effect and electrical resistivity of tellurium. V. E. BOTTOM. *Science*, **115**, 570-1 (May 23, 1952).

Measurements of the Hall constant R and resistivity ρ for various samples of high purity Te, prepared by multiple fractional crystallization in a He atmosphere, are reported. For all samples with less than 10^{17} cm^{-3} free carriers at room temperature R is negative over a certain temperature range, although at high and low temperatures R indicates p -type conduction. The lower reversal temperature is related empirically to the free carrier concentration; the upper reversal temperature is fixed at 230°C for all samples. Neither the sign nor magnitude of R for single crystals is dependent on crystal orientation. The intrinsic ρ at 27°C is approx. 0.5 ohm cm , but this quantity depends on crystal orientation. The intrinsic gap width is $0.33 \pm 0.01 \text{ eV}$. C. A. HOGARTH

537.311.33 : 538.632

6511. Interpretation of the double reversal of the Hall effect in tellurium. H. FRITZSCHE. *Science*, **115**, 571-2 (May 23, 1952).

See preceding abstract. The higher reversal temperature is explained by considering the number of lattice defects which depend on temperature and on the approximate activation energy. The mobility ratio is determined as 1.7. Graphs are given for the temperature variation of the various defect concentrations, and their intersections with a given exhaustion concentration of free carriers yield accurate values of the reversal temperatures. C. A. HOGARTH

537.311.33

6512. Further results in the general theory of barrier layer rectifiers. P. T. LANDSBERG. *Proc. Phys. Soc. [Lond.] B*, **65**, 397-409 (June, 1952).

It is pointed out that the temperature variation $V_D = a - bT$ of the diffusion potential, as deduced from the forward characteristic of rectifiers, is in broad agreement with theory. Hence formulae are derived for the temperature variation of the zero resistance of a rectifier having an arbitrary distribution of impurity centres, and subject to either diode or diffusion theory. Interpretation of experiments with the aid of these formulae leads to the temperature dependence of (a) the effective mass of current carriers in Ge rectifiers, and (b) of the mobility of current carriers in Se rectifiers. The latter curve has the same form as that obtained from Hall effect measurement, and it is pointed out that it is of broadly the same shape as the corresponding curves for high resistivity samples of Si and Ge. It is shown that two d.c. characteristics of the same rectifier, but corresponding to different temperatures, can intersect. Formulae for the applied voltage and the temperature rise which lead to the onset of thermal instability are deduced for all impurity centre distributions, and for diode and diffusion theory. A general theory of

current creep in rectifiers is outlined, and good agreement obtained with experiments on Se rectifiers. A.

537.311.33 : 621.3.011.5 : 621.314.634

6513. Breakdown in selenium rectifiers. R. COOPER. *Proc. Phys. Soc. [Lond.] B*, **65**, 409-14 (June, 1952).

The paper describes an experimental investigation of breakdown in Se rectifiers. Cooling from about 110°C to -74°C caused the breakdown voltage to decrease continuously, and at the same time anomalous behaviour was observed in the current-voltage characteristics. When high voltages were applied, the current decreased as the temperature increased, but at low voltages rise in temperature caused the current to increase. The effect of changing the thermal dissipation constant was similar to that caused by a change in ambient temperature. Reduction in the dissipation constant, effected by placing the rectifier in a vacuum, was observed to increase the breakdown voltage, but the leakage current at low voltages also increased. None of the available theories appears to account satisfactorily for the observations. A.

537.311.33

6514. Rectification phenomena exhibited by natural and sulphurized galena. A. L. REIMANN AND J. V. SULLIVAN. *Proc. Phys. Soc. [Lond.] B*, **65**, 480-7 (July, 1952).

Specimens of n -type galena were sulphurized, either by a wet chemical process or by exposure to sulphur vapour at various temperatures, and the resulting changes in rectification characteristics were observed, both with d.c. instruments and at 3000 Mc/s, using various cats-whiskers. According to treatment given, either an improved n -type rectification was obtained or the polarity was changed to p -type. The results are briefly discussed in the light of present-day rectification theory. A.

537.311.37

6515. The kinetic formulation of conduction problems. R. G. CHAMBERS. Letter in *Proc. Phys. Soc. [Lond.] A*, **65**, 458-9 (June, 1952).

Simplified and generalized derivations are given of some equations due to Huxley [Abstr. 1008 (1952)] for the conductivity of a gas containing free electrons.

P. T. LANDSBERG

537.312.5

6516. On the response of barrier layer cells. A theory predicting the variations of potential as a function of illumination and shunt resistance for a selenium barrier layer photocell. G. BLET. *C.R. Acad. Sci. [Paris]* **234**, 2187-9 (May 26, 1952) *In French*.

537.312.5

6517. Impedance measurements on PbS photoconductive cells. E. S. RITTNER AND F. GRACE. *Phys. Rev.*, **86**, 955-8 (June 15, 1952).

It is concluded from an analysis of existing and of new impedance measurements on PbS photoconductive cells that the observed decrease in parallel resistance with frequency is attributable to a known effect of distributed capacitance and should no longer be cited as convincing evidence for the existence of

internal barriers in these photocells. These results, however, should not be construed as evidence against a barrier picture.

A.

537.312.5

6518. Antimony content and photoelectric effect in different lead glazes. J.-E. HILLER AND H. G. SMOLCZYK. Note in *Naturwissenschaften*, **39**, 208 (No. 9, 1952) *In German*.

Measurements of the photovoltaic effect were made on 57 specimens of lead sulphide embedded in Wood's metal with tungsten wire contact on the sulphide and with the contact illuminated. Of these specimens 8 showed current flow from contact to PbS (defect conduction), 23 showed a weaker opposite flow of current and 3 showed little effect at all. The defect conductors contained less than 0.03% Sb and, the excess conductors more than 0.05% Sb. Other specimens showed no definite correlation.

G. F. J. GARLICK

537.312.5 : 535.215.4

6519. Photoeffect in Cs-Ga, Cs-In, and Cs-Tl photocathodes. N. SCHAEFFI, W. BAUMGARTNER AND C. FLURY. *Helv. Phys. Acta*, **24**, 609-13 (No. 6, 1951) *In German*.

The manufacture of these photocells is a difficult one due to the low melting point of the metals. The photoelectric conversion efficiency for a source at 2360°K is, for Cs-Ga, 1 μ A/L; Cs-In, 1.5 μ A/L; Cs-Tl, 0.5 μ A/L. The long wave threshold is very little dependent on the Cs content and moves towards longer waves in the order of Ga, In, Tl, i.e. with increasing atomic weights. The alkali metal alloys are highly sensitive in the u.v. range. The electrical conductance is similar to that experienced in Cs-Sb layers. The addition of 20% by weight of In to Sb and using this alloy to make a Cs-Sb photocell reduced the sensitivity to 4200 Å by 30% (characteristic now similar to that of a Li-Sb cell); while the addition of 20% of Tl to Sb resulted in an increase of the sensitivity to 4200 Å by 60%. Multi-alloy cathodes make it possible to produce photocells to a given specified spectral characteristic.

W. SUMMER

537.312.5 : 535.343.2

6520. Soft and hard *F*-centers. J. J. MARKHAM. Letter in *Phys. Rev.*, **86**, 433 (May 1, 1952).

The idea of soft and hard *F*-centres, the first easily bleached and the second almost unaffected by light, postulated by Oberly [Abstr. 1804 (1952)] is considered unnecessary to explain his results. The usual *F*-centre model can be employed if the *F*-band irradiation is assumed to decrease the photoelectron range by increasing the number of negative ion vacancies.

G. F. J. GARLICK

537.312.5 : 535.343.2

6521. Photoconductivity of trapped electrons in KCl crystals between 24°C and -190°C. J. J. OBERLY. Letter in *Phys. Rev.*, **86**, 799 (June 1, 1952).

The spectral response of photoconductivity in X-rayed KCl is studied from 24° to -190°C and results similar to those for KBr are obtained [see Abstr. 1804 (1952)]. The *F*-band response disappears as the temperature decreases below -32°C and at lower temperatures the *R*, *M* and *N* bands disappear leaving

the *L* band response (4800 Å) and a new *O* band at 15 000 Å. Theoretical discussion of the behaviour is provided.

G. F. J. GARLICK

537.312.5 : 535.5 : 621.383.277

6522. Polarization effects in photomultiplier tubes. E. P. CLANCY. Letter in *J. Opt. Soc. Amer.*, **42**, 357 (May, 1952).

Studies in the variation in response of 1P21 and 931A photomultipliers to plane polarized light with angle between the electric vector and the tube axis show that response, for 931A types, is greatest for angles of about 90° decreasing to 84% of the maximum at 0°. Effects are more pronounced in 931A type than in 1P21 type tubes.

G. F. J. GARLICK

537.312.5 : 621.383.5

6523. Photoelectric properties of ionically bombarded silicon. E. F. KINGSBURY AND R. S. OHL. *Bell Syst. Tech. J.*, **31**, 802-15 (July, 1952).

In the course of investigation of the rectifying properties of silicon very interesting photoelectric properties were found. The first photo-cells were cut from bulk silicon in which a natural potential barrier was found. A typical spectral characteristic of such a cell is shown. This early work was followed by the discovery of the ionic bombardment method of producing photo-active silicon surfaces. The effects of the temperature of the target and of the energy of the bombarding particles on the photoelectric properties is illustrated by characteristic curves. Relative equi-energy spectral response characteristics as a function of wavelength are illustrated. The photon efficiency as a function of wavelength of a typical cell is shown.

A.

537.312.6

6524. Attempt at interpreting the law relating the resistance of thermistors to the temperature. Y. DOUCET AND J.-P. GUIGNARD. *C.R. Acad. Sci. [Paris]* **234**, 1856-8 (May 5, 1952).

The resistance of thermistors was measured to an accuracy of 1 part in 1000 at five fixed points and the results are used in a discussion of the mechanism of conduction in thermistors. It is found theoretically that the conductivity should vary as $T^{3/2}$ if the mobility remains constant.

C. A. HOGARTH

537.312.62

6525. Thermal conductivity in the intermediate state of pure superconductors. D. P. DETWILER AND H. A. FAIRBANK. Letter in *Phys. Rev.*, **86**, 574 (May 15, 1952).

In and Sn behave analogously to Pb [Abstr. 1020 (1952)].

H. LONDON

537.312.62

6526. Gyromagnetic effect in a superconductor. R. H. PRY, A. L. LATHROP AND W. V. HOUSTON. *Phys. Rev.*, **86**, 905-6 (June 15, 1952).

The gyromagnetic ratio of a superconducting tin sphere has been measured by the Einstein-DeHaas method. The result is approximately that to be expected on the picture of perfectly free superconducting electrons and is in agreement with the work of Kikoin and Gubar.

A.

537.312.67

6527. The effect of transformation stress on electrical resistance of pure iron at A_3 point. M. SATÔ. *Proc. Japan Acad.*, **26**, 42-4 (June, 1950).

The abrupt change of electrical resistance on heating or cooling through the A_3 point is ascribed to the large internal stress accompanying the transformation. The change in resistance (amounting to about 0.5%) due to pressure is calculated and the result found to agree with recent measurements.

M. R. HOPKINS

537.312.67

6528. The effects of pressure on electrical resistance and thermal conductivity of metals at melting points. M. SATÔ. *Proc. Japan Acad.*, **26**, 32-5 (July, 1950).

An attempt to relate the change in electrical resistance of a metal on melting to the "transformation pressure" due to the change in specific volume.

M. R. HOPKINS

537.323

6529. On the sign of the thermo-e.m.f. of silicon. J. SAVORNIN AND F. FOURRIER-SAVORNIN. *C.R. Acad. Sci. [Paris]* **234**, 2165-7 (May 26, 1952) *In French*.

Measurements of the magnitude and sign of the thermo-electric power of couples between Si of low purity and various metals are reported.

C. A. HOGARTH

537.323

6530. On the question of the thermoelectric power of selenium. I. P. SHAPIRO. *Zh. Tekh. Fiz.*, **21**, 717-19 (No. 6, 1951) *In Russian*.

Crystalline Se, heated from 18°C to 60°C, approximately doubled its thermoelectric power, which also fell to zero after 80 minutes in the presence of Hg vapour at 50°C. The cause of these phenomena is discussed.

F. QUELON

ELECTRIC DISCHARGES 537.52

537.523.4

6531. On the spectra and colour temperature of very high voltage sparks in air. A. VASSY, H. NÖRINDER AND E. VASSY. *C.R. Acad. Sci. [Paris]* **234**, 1957-9 (May 12, 1952) *In French*.

Describes spectroscopic expts on long sparks in air, using a 2.3 MV generator, and gap lengths varying from 17-155 cm. From the spectra, which are briefly described in this note, colour temperatures ~16 000-21 000°K were deduced.

J. D. CRAGGS

537.523.4 : 536.422 : 621.316.923

6532. On the development of wire explosions. B. EISELT. *Z. Phys.*, **132**, 54-71 (No. 1, 1952) *In German*.

Gives references to the literature on electrically exploded wires (rapid volatilization of thin wires subject to condenser discharges). The experimental techniques are described, and detailed consideration is given to observations of the dark period which occurs between the initial explosion and the later growth of luminosity. The discharge mechanisms are discussed.

J. D. CRAGGS

537.523.5

6533. Characteristics of the high current tungsten arc in argon, helium, and their mixtures. M. SKOLNIK AND T. B. JONES. *J. Appl. Phys.*, **23**, 643-52 (June, 1952).

W-rod electrodes were used over a current range from 10 to 100 A. Measurements of the voltage-current and the voltage-electrode separation characteristics were made along with the plasma voltage gradients in both the pure gases and in the mixtures. It was found that this type of arc was very stable when the system was free from oxide impurities and that the cathodic processes played a major role in the arc mechanism. The results obtained suggest that the value of the anode voltage drop for the inert gas arc over the current range studied is negligibly small. At the higher currents or with smaller diameter cathodes, W was able to evaporate from the cathode in sufficient quantities to influence the character of the discharge. It was observed that the properties of the arc in mixtures of gases were in between the properties observed in the pure gases. The lower ionization potential gas, A, had more effect on the properties of the arc in mixtures than did He. As long as there was at least 15% A present in the mixture, the arc properties and appearance were more like those observed in A than in He.

A.

537.523.5 : 621.315.618 : 621.3.015.5

6534. Observations on the electrical breakdown of gases at 2800 Mc/s. II. Relative breakdown stresses, statistical lags and formative lags. W. A. PROWSE AND W. JASINSKI. *Proc. Instn Elect. Engrs, Pt IV*, **99**, 194-203 (July, 1952) [*Monogr. No. 32*].

For abstract, see Abstr. 2727 (1952).

537.523.5 : 621.316.932

6535. On the striking characteristics of arc gaps. P. WILDI. *Diss. E.T.H., Zürich*, No. 2045, 42 pp. (1951) *In German*.

A comprehensive account of experiments on the striking voltages of long a.c. arcs, as in h.v. transmission systems, and on the re-striking voltage of the arc gap as a function of the time elapsing after a previous arc had been interrupted. Many oscillograms, with time, voltage and current oscillograms are given.

J. D. CRAGGS

537.525

6536. The concentration of excited atoms in a mercury discharge. YU. M. KAGAN AND N. P. PENKIN. *Izv. Akad. Nauk. SSSR, Ser. Fiz.*, **14**, 721-6 (No. 6, 1950) *In Russian*.

On the excitation of atoms in the class of mercury. V. FABRIKANT AND B. YAROVSKIĬ. *Zh. Eksper. Teor. Fiz.*, **21**, 1180-1 (No. 10, 1951) *In Russian*.

On the excitation of atoms in the class of mercury. YU. KAGAN AND N. PENKIN. *Ibid.*, 1182-3. *In Russian*.

537.525

6537. Influence of the electrode-surface on the Joshi-effect in chlorine. P. G. DEO. *Indian J. Phys.*, **25**, 468-72 (Oct., 1951).

The Joshi effect was studied in chlorine (162 mm Hg pressure) contained in five ozonizers of different lengths but of identical electrode diameters in the potential range 1-8 kV. Both the net and relative

Joshi-effect increased by increasing the ozonizer length, which is a measure of the excited electrode area. This increase shows saturation, especially at low exciting potentials. The results are in accord with Joshi's theory that an adsorption-like electrode surface layer consisting of ions and electrons derived from the discharge space is a primary seat of this phenomenon. A.

537.525 : 535.337

6538. Influence of Joshi effect on the emission spectrum of chlorine. P. G. DEO. *Indian J. Phys.*, **25**, 530-2 (Nov., 1951).

When irradiated by 4750-4000 Å the relative Joshi effect, $\% \Delta i$, ($100 \Delta i / i_{\text{dark}}$) in 100 mm chlorine was a maximum, viz. 86, at the threshold potential 6.9 kV, the corresponding glow intensity was extremely low. Increase of potential increased the intensity but diminished $\% \Delta i$. With 120 hours' exposure, the spectrum was recorded (i) with the tube excited at 11.3 kV; (ii) with the tube excited and also irradiated by 4750-4000 Å, the $\% \Delta i$ being 70, and (iii) with the tube unexcited but irradiated. The intensity distribution in the spectrum was recorded with a microphotometer in each of twelve sets of results for (i), (ii) and (iii). The spectral intensity was found to diminish by irradiation outside its wavelength limits. This is attributed to a decrease in the population of excited particles in the ionized and pre-ionized states. A.

537.525.3 : 537.525.72 : 537.525.8

6539. Seat of Joshi effect in a.c. silent discharges. S. R. KHAISTGIR. Letter in *J. Chem. Phys.*, **20**, 1052-3 (June, 1952).

Demonstrates the dependence of negative and positive Joshi effects on the electrode regions of a corona (ozonizer) discharge in iodine vapour and hydrogen.

J. D. CRAGGS

537.529 : 537.226.8

6540. Formation and annulment of space charges in glass and their influence on electric breakdown. K. J. KELLER. Letter in *Phys. Rev.*, **86**, 804 (June 1, 1952).

Describes expts on the impulse breakdown of glass, and demonstrates the importance of controlling any pre-stressing or annealing treatment. J. D. CRAGGS

X-RAYS 537.531

537.531 : 535.33

6541. Soft X-ray *L*-spectra of Fe, Co, Ni, Cu and their oxides. K. D. GUPTA AND S. B. BHATTACHERJEE. *Indian J. Phys.*, **25**, 555-9 (Nov., 1951).

$L_{2,3}$ band spectra of Fe-Cu and their oxides have been investigated in the region 13-18 Å with bent mica and gypsum crystals in a Siegbahn vacuum grating spectrograph. L_3 bands of Fe, Co, Ni have more or less the same energy width of 13-16 eV. In these elements a weak extended structure on the short wavelength side of the main $L\alpha$ band has been observed. The main $L\alpha$ band having a width of 5 eV approximately, along with its extended structure on

the shorter wavelength side, is considered to be the valence band of these elements. AA

537.531 : 535.33.03

6542. Non-quadrupole lines in X-ray spectra. G. B. DEODHAR AND C. MANDE. Letter in *Nature [Lond.]* **169**, 889 (May 24, 1952).

A study of the *L*-spectrum of platinum and mercury leads to selection rules, and shows that the observed quantum energies are slightly less than the theoretical. A. R. STOKES

537.531 : 535.33.07

6543. A large bent crystal vacuum spectrograph. A. E. SANDSTRÖM. *Ark. Fys.*, **4**, 517-34 (Paper 366 1952).

The spectrograph is designed for the long-wave region. The crystal mounting depends on a lever system similar to one used for grating spectrographs [M. Siegbahn, *Spektroskopie der Röntgenstrahlen*, 2nd ed. Berlin (1931), p. 76]. A linear relation between wavelength and displacement is obtained. The construction is described in detail. A. R. STOKES

537.531 : 535.34.3

6544. Study of the form and intensity of the satellite band accompanying the $L\beta_2$ -ray of gold. L. SALGUEIRO AND J. GOMES FERREIRA. *Portugal. Phys.*, **3**, 117-25 (No. 2, 1951) In French.

35-kV X-rays and a quartz crystal spectrograph were used. Results are given as curves; detailed comparisons with other authors are also made. $I_{\text{sat.}}/I_{L\beta_2}$ was found to be 0.11. F. R. HOLZ

537.531 : 535.42 : 532.74

Diffraction of X-rays by liquid alloys of Na and K. See Abstr. 6328

CATHODE RAYS . POSITIVE RAYS 537.533/533.3

537.533

6545. Radiation intensity from high energy accelerators. J. D. LAWSON. *Brit. J. Appl. Phys.*, **3**, 214-10 (July, 1952).

It is shown that the forward radiation intensity from high-energy electron accelerators may be calculated quite simply for targets of thickness up to 0.1 radiation length, and that an estimate to within about 15% is often possible for considerably thicker targets. A measurement of the forward radiation from a linear accelerator with a thick copper target operating at 7.3 MeV was made by means of a thick-walled ionization chamber, and found to be in satisfactory agreement with theory. A

537.533.

6546. The dispersion of electron beams in gases. P. F. LITTLE AND A. VON ENGEL. Letter in *Proc. Phys. Soc. [Lond.] B*, **65**, 459-60 (June, 1952).

Electron beams of energy 3-10 keV remain concentrated in nitrogen even at pressures of 1 mm Hg. This transcends the accepted upper limit by two orders of magnitude. Qualitative calculations relating to the effect are given. A. H. W. BECK

537.533.7

6547. An hysteresis effect in the transmission of electrons through thin dielectric foils. P. H. OWEN AND C. S. COOK. *Phys. Rev.*, **86**, 961-3 (June 15, 1952).

The relative transmission of monoenergetic electrons through a dielectric foil suspended in vacuum has been observed to depend upon the previous history of the foil. A plot of this transmission against energy of incident electrons shows something resembling a type of hysteresis loop. Experiments are discussed which give evidence that this hysteresis loop is produced through the collection of negative charge within the foil.

A.

537.533.7 : 621.384.62

6548. An experimental study of an electron accelerator. J. VASTEL. *Ann. Radioélectricité*, **7**, 20-33 (Jan., 1952) In French.

The experimental work carried out in designing a linear accelerator whose circuit is a disk-loaded circular waveguide is described in detail. The design of the circuit for the $\pi/2$ mode at 3000 Mc/s and measurements of the resulting performance form the bulk of the paper. A section 25 cm long gave electrons of max. energy $\simeq 450$ keV. The energy for max. intensity $\simeq 400$ keV.

A. H. W. BECK

537.533.72

6549. Electron ballistics in the light of the Laplace transform. B. BERKEŠ. *Glasn. Mat.-fiz. Astron.*, **6**, 217-22 (No. 5, 1952) In Serbo-Croat.

The use of Laplace-transform methods to calculate electron trajectories in a given e.m. field is illustrated by application to a number of simple field systems.

R. H. DALITZ

537.533.72

6550. Non-paraxial theory of the elliptic electrostatic lens. E. REGENSTREIF. *Ann. Radioélectricité*, **6**, 299-317 (Oct., 1951) In French.

Fuller version of Abstr. 1050 (1952). The effect of ellipticity is supposed to be confined to the central region of the lens; where the refraction is weak, axial symmetry is assumed. Within this limitation, however, the theory is exact, i.e. it is not a perturbation theory, so that the ellipticity is not necessarily extremely small. Some discussion of aberration figures is given.

J. C. E. JENNINGS

537.533.72

6551. Theory of the electrostatic lens formed by two coaxial cylinders. P. GRIVET AND M. BERNARD. *Ann. Radioélectricité*, **7**, 3-9 (Jan., 1952) In French.

The first part of this paper is a fuller version of Abstr. 1049 (1952). It is also shown that ϕ/ϕ approx. $\propto \text{sech}(z/b)$, so that the results of Abstr. 1051 and 3629 (1952) are applicable. Numerical results from each method are given and compared with calculations of Goddard [Abstr. 263 (1945)] and observations of Spangenberg and Field [Abstr. 989 B (1944); *Elect. Commun.*, **21**, 194 (1943)]. The discussion is paraxial but it is suggested that the method of Sturrock for 3rd-order aberrations [Abstr. 9520-1 (1951)] might be applied to either of the present approx. ray equations.

J. C. E. JENNINGS

537.533.72 : 621.385.833

6552. An approximation method for image aberration calculation in electron optics. M. BARBIER.

Diss. E.T.H., Zürich No. 1932, 88 pp. (1951), Mitt. Inst. Tech. Phys. No. 3. In German.

The author first investigates the errors introduced into the calculated paraxial paths by the assumption of an axial potential distribution different from the correct value. It is shown that the axial field can be piece-wise approximated by fields for which the path is known. The results are sufficient for the calculation of chromatic errors. The 3rd-order aberrations are then treated and it is shown that only the 2nd derivative of the axial potential is required since the 4th derivative can be eliminated by partial integration. Formulae for the 3rd-order aberrations are given and the dependence on object and diaphragm positions is investigated. Two examples are treated in detail, the magnetic field of Glaser's type $y = (1 + x^2)^{-1}$, and the equal cylinder electrostatic lens. A. H. W. BECK

537.533.72 : 621.385.833

6553. A simple electrostatic electron-optical system with only one voltage. P. SCHAGEN, H. BRUINING AND J. C. FRANCKEN. *Philips Res. Rep.*, **7**, 119-30 (April, 1952).

A simple electron-optical system is described for application in television pick-up tubes or image converters. This system consists of two concentric spheres, the sphere with the smaller radius, the anode, being provided with a hole. The electron paths in the field of force appertaining to this system are calculated and the influence of the hole in the anode is estimated. These calculations indicate that an inverted image of the cathode can be obtained at a distance equal to $6(n-1)R_a/(n-4)$ behind the hole, the magnification of this image being equal to $3/(n-4)$, where n equals the ratio of the radii of the spheres and R_a represents the radius of the anode sphere. With experimental tubes, adapted to practical requirements, pictures of good resolution and geometry have been obtained. A.

537.533.72 : 621.385.833

6554. Electron optical velocity filters. M. SCHIEKEL. *Optik*, **9**, 145-53 (No. 4, 1952) In German.

Gives the theory of the "Einzellinse" when used with negative central electrode and acting as a velocity filter. It is proposed to use the filter for preventing electrons inelastically scattered from the object from reaching the screen, with resultant improvement in contrast. The optimum resolving power is about $110\text{\AA}$.

A. H. W. BECK

537.533.72 : 621.385.833

6555. The current in the electron immersion objective. L. JACOB. *Proc. Phys. Soc. [Lond.] B*, **65**, 421-5 (June, 1952).

It is shown that for an electron immersion objective under the condition of constant cut-off voltage the emission current is uniquely defined by the cross-over potential. There is thus some theoretical foundation for the empirically observed law that the current at zero modulation voltage depends only on (cut-off voltage) $^{1/2}$.

A.

537.533.72

6556. The motion of electrons in the field of a homogeneously wound toroid. S. G. NILSSON. *Ark. Fys.*, **4**, 347-51 (Paper 17, 1952).

Investigates the focal properties of the toroid in the relativistic case (β -ray spectroscopy). The

differential equation is set up and an approximate solution found. This yields an expression for the focusing angle. The optimum form of entrance slit is investigated and turns out to be an ovoid curve.

A. H. W. BECK

537.533.74

6557. A study of coincidence pulses obtained in a 4π counter from radioelement ^{32}P . F. SUZOR AND G. CHARPAK. *C.R. Acad. Sci. [Paris]* **234**, 720–2 (Feb. 11, 1952) *In French*.

Continuation of work described in Abstr. 3635 (1952).

537.533.74

6558. The scattering of positrons. N. CUSACK. *Phil. Mag.*, **43**, 671–6 (June, 1952).

The scattering by N of positrons from Cu^{64} was observed with the Wilson chamber and analysed by the method of projected angles. The ratio of observed to theoretical numbers of scattering events was 0.63 for 114 nuclear scattering angles $>20^\circ$. The results are considered together with the other relevant work and the conclusion drawn that, while the theoretical cross-sections describe correctly the large scale variations of scattering with energy, Z , and angle, the spin terms in the formulae have not been adequately tested. Positron-electron collisions were also observed, the ratio expt./theory being 1.1 for 40 events with scattering angle $>15^\circ$. No confirmatory evidence could be found for previous suggestions that the losses of energy accompanying positron nuclear scattering are unexpectedly frequent.

A.

537.533.74

6559. On the scattering of fast electrons by nuclei. L. R. B. ELTON. *Proc. Phys. Soc. [Lond.] A*, **65**, 481–4 (July, 1952).

It is shown that, contrary to expectations from the non-relativistic case, the phase-shift ζ_n between the partial waves of electrons scattered by a point nucleus and by an extended nucleus respectively is positive for sufficiently large n , and that this is a spin effect and not merely a relativistic one. An approximate formula for ζ_n is evolved and its usefulness is discussed.

A.

537.533.75

6560. Relative transmission of beta particles through G-M counter windows. C.-H. CHANG AND C. S. COOK. *Nucleonics*, **10**, 24–7 (April, 1952).

The source holder of a magnetic-lens β -spectrometer was adapted so that a negative accelerating potential of 5 kV (retarding—in the case of positrons) could be applied to β -particles emitted from the source. The source was plated on to a small sphere and the accelerating field was made spherically symmetrical in order to avoid distortion of the observed β -spectrum. By this means it was possible to study the β -spectrum of the source with and without an energy displacement of 5 kV. A comparison of the two spectra leads to the ratio between the spectrometer counter window transmission to electrons of energy $E + 5$ keV and that to electrons of energy E keV over the range of energies available in the given spectrum. The relative transmission of the counter window can then be given as a function of electron energy. Experiments were carried out with Ag^{110} and positrons from Cu^{61} and results are given for a

7.32 mg/cm² Al window and a 2.0 mg/cm² cellophane window.

L. R. SHEPHERD

537.533.75 : 778.34

6561. Grain density in tracks of electrons moving at relativistic velocities in photographic emulsions. A. H. MORRISH. *Phil. Mag.*, **43**, 533–7 (May, 1952).

The grain density increases by about 5% between the energies 9 and 25, measured in rest mass units, thereafter remaining constant at least up to $E/mc^2 \sim 10^4$.

A.

537.533.88

6562. On the theory of secondary electron emission. J. L. H. JONKER. *Philips Res. Rep.*, **7**, 1–20 (Feb., 1952).

Starting from (1) Whiddington's law concerning the velocity loss of electrons penetrating into a solid substance, (2) the experimental absorption law and (3) the assumption that the distribution of the secondary electrons within matter is isotropic, the author calculates the behaviour of secondary electrons as a function of various parameters, which is found to be in good accordance with results obtained experimentally.

A.

537.533.88

6563. A note on Wooldridge's theory of secondary emission. E. M. BARODY. *Phys. Rev.*, **86**, 915–16 (June 15, 1952).

A re-examination of Wooldridge's theory shows that the broad maximum which he obtained in the curve of secondary emission coefficient against primary energy is a result of an inconsistency in approximations, rather than an essential result of his theory. In deriving an expression for the emission coefficient from the rate of excitation of valence electrons, an estimate was needed of the probability that a typical secondary would travel in a direction favourable for emission. In making this estimate, Wooldridge neglected the momentum received from the primary, which is small compared to that received from the lattice. The present calculation shows, however, that this neglected momentum is of just the right magnitude to eliminate or drastically modify the broad maximum obtained in the emission curve.

A.

537.533.8 : 621.385.15

6564. The equilibrium between an insulator emitting secondary electrons, a space charge and a fixed potential barrier. M. BARBIER. *Ann. Radioélectricité*, **7**, 61–7 (Jan., 1952) *In French*.

The surface potential of an insulator, with a secondary emission coefficient >1 , submitted to continuous electron bombardment is calculated taking into account the space charge formed. This potential may be negative relative to the collecting electrode. The order of potential and charge values is indicated as function of bombardment intensity, secondary emission coefficient and distance between the surface and collector.

A. SZCZANIECKI

537.533.9

6565. Experimental evidence for classical electron radiation at 300 MeV. J. W. MATHER. Letter in *Phys. Rev.*, **86**, 795 (June 1, 1952).

The rate of radiation of an electron (300 MeV) moving in a circular orbit is obtained from observation of the time at which the electron reaches its

radial turning point after the r.f. turn-off in the electron synchrotron. This rate is found to agree with the classical expression, contrary to the calculation of Parzen [Abstr. 330 (1952)].

R. H. DALITZ

537.534

6566. A new type of accelerator. H. ALFVÉN AND O. WERNHOLM. *Ark. Fys.*, **5**, 175–6 (*Paper 12*, 1952).

A new positive-ion accelerator is proposed in which the accelerating electric field is provided by the space-charge of a moving concentration of electrons. Electrons continuously produced from a long cathode are accelerated to perhaps 50 kV and passed between two pairs of capacity-loaded Lecher wires lying parallel to the cathode. A high-frequency magnetic field produced by these will bring the electrons from a short length of cathode to a sharp focus which will travel along with the velocity of the field, and positive ions may be trapped into the space-charge field at the rear of the focus.

J. H. FREMLIN

537.534 : 538.2 : 621.384.61 : 621.318.3

6567. Synchrotron magnet construction. O. WERNHOLM. Letter in *J. Sci. Instrum.*, **29**, 166–7 (*May*, 1952).

In the conventional design of synchrotron magnets the betatron flux is achieved by placing magnetic shunts inside the guide field poles. This arrangement produces eddy currents in the field magnet which in turn produce field irregularities which need to be corrected. These irregularities can be appreciably reduced with a construction using a separate magnetic circuit for the betatron similar to that used by Kerst [Abstr. 7287 (1950)]. Inside the pole gap is a back-wound coil, with the same number of turns as the magnetizing coils, which prevents flux leakage from the poles to the betatron core. Correction coils are now unnecessary, the total inductance of the magnet is lower, the non-linearity of the inductance of the betatron coil has less influence on the total inductance.

S. C. DUNN (R)

537.534 : 621.319.339

6568. Simple Van de Graaff generators with double-belt charging. A. FLAMMERSFELD AND G. WEBER. *Z. Naturforsch.*, **7a**, 161–4 (*Feb.*, 1952) *In German*.

By charging the belt on both sides, and using a potential distributing system, the current yield was increased 1.7 times. Practical details are given.

J. HUGHES

537.534 : 621.384.61

6569. Synchrotron-oscillation resonance. N. M. BLACHMAN. Note in *Rev. Sci. Instrum.*, **23**, 250 (*May*, 1952).

The theoretical variation of phase oscillation in the Brookhaven proton synchrotron has been investigated. Ripple modulation of the r.f. or of the magnet introduces a "forcing" term into the phase-oscillation equation, and this equation has been numerically integrated on the National Bureau of Standards computer SEAC. Even a large "forcing" term is found not to result in instability.

J. H. FREMLIN

537.534 : 621.384.61

6570. Optical focusing in constant radius accelerators. D. C. DEPACKH. Letter in *Phys. Rev.*, **86**, 433 (*May 1*, 1952).

A method of focusing the beam while its energy is

still small is described. A series of magnetic lenses spaced uniformly round the acceleration tube is used and has been shown experimentally to give excellent focusing on a low-aperture accelerator of radius 2½ ft.

J. H. FREMLIN

537.534 : 621.384.611

6571. Notes on the 225-cm cyclotron at the Nobel Institute for Physics, Stockholm. H. ATTERLING AND G. LINDSTRÖM. *Ark. Fys.*, **4**, 559–63 (*Paper 40*, 1952).

The initial performance of the 225 cm cyclotron at Stockholm is described. This is designed to give 25 MeV deuterons at a radius of 90 cm with a field of 11 500 Oersteds. The dees are insulated from ground for d.c. and are biased 500 V negatively to prevent discharges in the tank. A few microamps have been accelerated to full radius at 21 MeV.

J. H. FREMLIN

537.534 : 621.384.62

6572. Expression of the electromagnetic field in linear ion accelerators. M. BERNARD. *C.R. Acad. Sci. [Paris]* **234**, 1862–5 (*May 5*, 1952) *In French*.

The solutions of Maxwell's equations are given in a semi-infinite cylinder closed by a metal plate perpendicular to the axis. This arrangement is used in linear accelerators to achieve radial stability. The treatment may be extended to similar problems.

L. PINCHERLE

537.534.74

6573. An investigation into the nuclear scattering of high energy protons. K. M. GATHA AND R. J. RIDDELL, JR. *Phys. Rev.*, **86**, 1035–9 (*June 15*, 1952).

The angular distributions of high-energy protons, elastically scattered from various nuclei, have been considered theoretically. For this purpose, the optical model of the nucleus, hitherto developed on the basis of the nuclear scattering of high-energy neutrons, has been suitably modified to account for the proton scattering. Appropriate proton wave equations have been established and solved exactly. However, these solutions have been found unsuitable for numerical computations. Next, the WKB and the Born approximations have been used, within their respective regions of validity, to yield appropriate expressions for the differential scattering cross-section. Finally, the theoretical and the experimental diffraction patterns for the nuclear scattering of 340-MeV protons have been compared. It has been found that the above nuclear model gives only an approximate account of such a scattering. It is further indicated that the effective nuclear radii, appropriate for this energy, are about 10% smaller than those calculated on the basis of the nuclear scattering of 90-MeV neutrons.

A.

DISCHARGE TUBES . COUNTERS 537.54

537.542

6574. The accurate counting of β -rays with a proportional counter. L. KOESTER AND H. MAIER-LEIBNITZ. *S.B. Heidelberg Akad. Wiss. (Math.-naturw. Kl.) No. 5*, 10 pp. (1951) *In German*.

It was found that a proportional counter filled to atmospheric pressure with methane gave a plateau, for

counting β -rays, with a slope of 0.1%/100 volts. Some unexplained deterioration was found in the plateau after $\sim 10^9$ counts. J. HUGHES

537.542

6575. On an X-ray counter tube, insensitive to wavelength. R. GLOCKER, G. FROHNMEYER, R. BERTHOLD AND A. TROST. Note in *Naturwissenschaften*, **39**, 233 (No. 10, 1952) In German.

Shows that wavelength changes have little effect on the sensitivity of a Plexiglas counter tube for X-ray energies varying from about 30–230 kV. Variations in sensitivity over the 12–30 kV range are greater but still small. J. D. CRAGGS

537.542 : 621.387.424

6576. Geiger-Müller counters. N. WARMOLTZ. *Philips Tech. Rev.*, **13**, 282–92 (April, 1952).

The historical development of G.-M. counters is discussed with reference to the properties of gas discharges, with an indication of the various ways in which a gas-discharge tube can be used for counting ionizing particles or quanta. Particular consideration is given to the properties of counting tubes in the "Geiger-Müller range" (plateau) and the classification of existing counters into those with statistical quenching and those with space-charge quenching. The properties of the argon-hydrogen counter, an example of a statistically quenched tube, and those of the counter with an organic gas as quenching agent, an example of a counter with space-charge quenching, are examined more closely. New self-quenching counters with halogen as quenching agent are described in various constructions and applications, mention being made, among others, of a low-voltage counter with a starting voltage of 250 V, some types of β - and γ -counters with mica window, and a counter of great sensitivity for X-rays of about 1 to 2 Å wavelength; these counters have a practically unlimited life. A.

537.542

6577. The saturation curve at high ionization intensity. J. W. BOAG AND T. WILSON. *Brit. J. Appl. Phys.*, **3**, 222–9 (July, 1952).

The form of the curve is investigated theoretically and experimentally. It is shown that saturation curves taken under different conditions on a parallel plate ionization chamber are transformed into a single general curve when plotted in terms of a dimensionless product of the several variables. The experimental work utilized an ionization chamber with thin foil electrodes. A coin-shaped region between the foils was ionized by a mean of fast electrons. Dose rates up to $100\,000\text{ e.s.u./cm}^2 \times \text{sec}$ could be attained. It is shown that very high ionization intensities can be measured in a parallel plate chamber, provided the spacing of the plates is small. A.

537.542

6578. A remark on the sulphur crystal counter. M. SAKAI AND F. LURÇAT. *C.R. Acad. Sci. [Paris]* **234**, 2061–2 (May 19, 1952) In French.

A renewed study shows that the observed pulses of ionization originated in the air spaces between the electrodes and not in the crystal. W. J. SWIATECKI

537.542

6579. Electrical counting properties of diamonds. F. C. CHAMPION. *Proc. Phys. Soc. [Lond.] B*, **65**, 465–72 (July, 1952).

Examination was made of over 200 diamonds, most of which were of gem quality and many of which weighed only a few milligrams. About 25 of them showed good conduction properties when submitted to ionizing radiations. For depths of crystal penetration which exceeded a certain amount, all the counting specimens responded to both α -particles and β -particles with a response which was at least qualitatively dependent on the energies of the particles. In some cases, however, a marked drop in the counting properties was easily demonstrated with α -particles under conditions of feeble penetration. Even at maximum penetration 5-MeV α -particles produced oscillograph pulses in such crystals which were only about three times as large as those from 1-MeV β -particles. Strong correlation was established between the wavelength of the continuous ultra-violet transmission limit and the magnitude of the electrical counting response of the specimen. A.

537.542

6580. Electrical counting response of two large diamonds under beta-irradiation. K. STRATTON AND F. C. CHAMPION. *Proc. Phys. Soc. [Lond.] B*, **65**, 473–80 (July, 1952).

Two large diamonds S_1 and S_2 , both of good optical quality, were subjected to β -irradiation and the electrical conduction responses were studied under a variety of conditions. With S_1 special attention was paid to the formation and removal of space charge. There is evidence that the mechanisms of space charge removal by β -irradiation and by illumination respectively are not quite the same. The efficiency of this diamond as a β -particle counter was not appreciably different from that of a standard Geiger counter. Small volume elements of S_1 and S_2 were examined individually for β -counting efficiency. While S_1 did not show a variation greater than 20%, variations as large as ten to one were found in different parts of S_2 . The results were not inconsistent with the existence of a correlation between the ultra-violet transmission and the counting efficiency of any selected volume element. The β -response of S_1 was more than three times the best response from S_2 under comparable conditions, while the ultra-violet transmission limits were 2250 and 2850 Å respectively. A.

537.542

6581. The response of a NaI scintillation counter to slow and fast neutrons. M. A. GRACE, H. R. LEMMER AND H. HALBAN. Letter in *Proc. Phys. Soc. [Lond.] A*, **65**, 456–7 (June, 1952).

537.542

6582. Characteristics of scintillation counters. G. F. J. GARLICK AND G. T. WRIGHT. *Proc. Phys. Soc. [Lond.] B*, **65**, 415–21 (June, 1952).

Experimental studies have been made of the distribution in size of output pulses from a scintillation counter detecting monoenergetic α -particles. Separate investigations have been made of contributions to the pulse size spread by the photomultiplier and by the scintillating crystal. It is shown that the main effect

is due to statistical fluctuations in the number of photoelectrons produced at the photomultiplier cathode. The effect of the multiplying stages on these fluctuations is investigated and also the effect of flaws in the detecting crystal. The frequency distribution of the pulses is usually found to follow the Gaussian form. A.

537.542 : 621.387.464

6583. Wide-range logarithmic radiation meter. R. E. BELL AND R. L. GRAHAM. *Rev. Sci. Instrum.*, **23**, 301-4 (June, 1952).

A logarithmic radiation meter is described using as detector, a photomultiplier and scintillation phosphor. A one-tube feedback circuit varies the voltage applied to the photomultiplier so as to hold its anode current constant for different incident radiation intensities. The voltage applied to the photomultiplier is then a nearly logarithmic measure of the radiation intensity over a range of 10^4 . Circuit details and experimental results are given of a battery-operated portable model and an a.c. operated model which incorporates means for correcting the slight compression towards one end of the scale found in the portable model. A.

537.542 : 621.387.464

6584. Latest developments in scintillation counting. *Nucleonics*, **10**, 32-41 (March, 1952).

Summaries of papers presented at a symposium on scintillation counters (Washington, Jan., 1952) are given. The topics discussed include afterpulsing in photomultipliers; time and energy resolution; new photomultiplier tubes; properties of various phosphors; use of lithium salts as phosphors in neutron detection; Cherenkov radiation counters; plastic phosphors; fast-pulse circuit techniques used in conjunction with scintillation counters in coincidence and short time measurement. L. R. SHEPHERD

537.542 : 778.3

6585. Nuclear emulsion and scintillation crystal processes. J. B. BIRKS. Letter in *Phys. Rev.*, **86**, 791 (June 1, 1952).

An analogy is suggested between the detection of nuclear particles by photographic emulsion and by luminescent crystals. The specific grain density dG/dr may be compared with the specific luminescence dL/dr for various values of specific energy loss dE/dr . G. F. J. GARLICK

537.542 : 621.318.572

6586. Pulse amplitude analyzers for spectrometry. G. G. KELLEY. *Nucleonics*, **10**, 34-7 (April, 1952).

Some important factors governing the design of pulse amplitude analysers are discussed briefly. The limitation on the pulse energy range which can be covered with a given number of channels without serious smearing of the spectrum, importance of high counting rates and influence of pulse and discriminator speed on channel width are considered. A pulse-lengthening circuit and a circuit for preventing a spurious record when two successive pulses occur in a time less than that required to analyse a pulse are described. L. R. SHEPHERD

537.542 : 621.396.615.17 : 621.18.572

6587. Fast pulse circuit techniques for scintillation counters. F. H. WELLS. *Nucleonics*, **10**, 28-33 (April, 1952).

Some fast pulse circuits used in scintillation counting

are described. These include a circuit for shaping photomultiplier output pulses, a photomultiplier pulse simulator and pulse generator giving pulses of duration down to $0.05 \mu\text{sec}$ and a fast oscilloscope for single pulse display with time bases down to $0.1 \mu\text{sec}$ duration. A particular feature of these circuits is the use of secondary-emission pentodes. L. R. SHEPHERD

537.542

6588. On an automatic Wilson cloud chamber in a magnetic field and some associated techniques. R. K. DAS. *Indian J. Phys.*, **25**, 481-90 (Oct., 1951).

A one-ton electromagnet for use in cosmic-ray research with a shallow cloud chamber is described. For convenience in photography, one of the pole pieces has been bored. The field strength attainable with a current of 7 amperes is about 3630 gauss over the effective region in the pole gap. A shallow cloud chamber, 2.5 cm deep and 15 cm in internal diameter, is used. A complete description of the automatic sequence control mechanisms is given. In automatic test runs, the performance of the apparatus has proved quite satisfactory. A.

537.542

6589. A low pressure helium continuous cloud chamber. W. J. CHOYKE AND C. E. NIELSEN. Note in *Rev. Sci. Instrum.*, **23**, 307-9 (June, 1952).

Describes a helium/alcohol chamber with special cooling arrangements, which are shown in a sketch. Specimen tracks of electrons from snow residues and from a weak samarium source are also shown.

537.542

6590. A diffusion cloud chamber with a diffusion current directed vertically upwards. P. HARTECK AND G. HERTZ. Note in *Naturwissenschaften*, **39**, 206-7 (No. 9, 1952) In German.

A brief account of an improved type of continuously sensitive cloud chamber in which vapour, produced at the surface of a liquid at the bottom of the chamber condenses on a cold plate near the top.

F. LLEWELLYN JONES

IONIZATION . THERMIONICS 537.56/.58

537.561

6591. Dissociation of molecular hydrogen ions in the cyclotron. K. E. A. EFFAT. *Proc. Phys. Soc. [Lond.] A*, **65**, 433-6 (June, 1952).

The dissociation of H_2^+ ions by collision with gas molecules greatly reduces the current of these ions that can be obtained from a cyclotron. The current has been measured at two distances from the ion source corresponding to energies of 9 and 18 MeV and with various pressures of air and argon in the tank; the loss of ions in expanding from the smaller to the larger radius is somewhat less than is predicted by Salpeter's calculations of the dissociation cross-section. Assuming this cross-section to be inversely proportional to the kinetic energy of the ion, the product σE is found experimentally to be $(1.9 \pm 0.4) \times 10^{-16} \text{ cm}^2 \text{ MeV}$ per "atom" of air and $(7.0 \pm 1.4) \times 10^{-16} \text{ cm}^2 \text{ MeV}$ per atom of argon. A.

537.561

6592. The appearance potential of C^+ in the mass spectra of some substituted methanes and the heat of sublimation of carbon. H. BRANSON AND C. SMITH. Letter in *J. Chem. Phys.*, **20**, 1047 (June, 1952).

Appearance potentials are consistent with $L(C) = 5.885$ eV or 135.7 kcal, not with 7.36 eV.

A. G. GAYDON

537.561 : 539.132

6593. Studies of ionization efficiency. II. The ionization potentials of some organic molecules. J. D. MORRISON AND A. J. C. NICHOLSON. *J. Chem. Phys.*, **20**, 1021-4 (June, 1952).

For Pt I, see Abstr. 362 (1952). The ionization potentials of some 83 organic molecules were measured with the mass spectrometer, using the critical slope method to interpret the ionization efficiency curves for the molecular ions. A self-consistent group of values was obtained in which the main relationships between ionization potential and molecular structure can be clearly distinguished. The results are compared with those obtained by spectroscopic and other methods, and some regularities in the discrepancies are pointed out.

A.

537.563

6594. Ionization phenomena which accompany the rupture of liquid surfaces. P. PANNETIER. *C.R. Acad. Sci. [Paris]* **234**, 1881-3 (May 5, 1952) In French.

Measurement of the ionization which accompanies the rupture of liquid surfaces is made by the static method [Bloch (1911)], since this can be carried out in the ionization chamber itself. Experimental details are included for the rupture of water and of aq.N/1000HCl, and the results are illustrated by curves.

H. H. HODGSON

537.58

6595. Thermal ionization of trapped electrons. R. KUBO. *Phys. Rev.*, **86**, 929-36 (June 15, 1952).

The rate of thermal ionization of an electron trapped on an impurity atom is treated on a quantum mechanical basis. From the standpoint of an adiabatic approximation, the multiphonon transitions are attributed to the dependence of the atomic vibrations on the electronic states. Approximate formulae based on an Einstein model are derived for the total ionization rate by using a generating function which is intimately related to density matrices. It is shown that the rate can be expressed as $256(m/M)\omega(\rho/2)\epsilon_0/\hbar\omega - 1 \exp(-\epsilon_0/kT)$ for low temperatures, where m is the mass of electron, M that of the atom, ω the frequency of atomic vibration, ϵ_0 the energy of ionization, and ρ is the fractional difference of the frequencies of atomic vibrations in the trapped and the ionized states, which can be of the order 0.1. For high temperatures we can expect a similar formula to that given by the activated states theory. Generally, we have reasons to expect much greater rates than those given by Goodman, Lawson and Schiff.

A.

537.583

6596. Thermionic emission and electrical conductivity of oxide-coated cathodes. S. NARITA. Letter in *J. Appl. Phys.*, **23**, 599 (May, 1952).

These properties were measured for sintered oxide-

coated cathodes (using an embedded probe) and compared with those for ordinary oxide-coated cathodes. It is believed that three mechanisms of electron conduction may occur: (a) conduction by electron gas in pores or through grains limited by contact barriers, (b) pure conduction through grains, and (c) surface conduction through Ba layers.

F. LLEWELLYN JONES

537.583

6597. Chemical reactions in barium oxide on tungsten emitters. R. C. HUGHES, P. P. COPPOLA AND H. T. EVANS. *J. Appl. Phys.*, **23**, 635-41 (June, 1952).

When $BaCO_3$ is heated in vacuum in contact with W, the following reactions may occur in sequence as progressively higher temperatures are reached: (1) $WO_3 + BaCO_3 \rightleftharpoons BaWO_4 + CO_2$. (2) $3BaCO_3 + W \rightleftharpoons Ba_3WO_6 + 3CO$. (3) $BaCO_3 \rightleftharpoons BaO + CO_2$. (4) $6BaO + W \rightleftharpoons Ba_3WO_6 + 3Ba$. At a temperature of approximately $600^\circ C$, reaction (2) begins to occur with appreciable speed. Reaction (3) proceeds at $800-900^\circ C$. Reactions (2) and (3) may be made to proceed simultaneously, the preponderance of one over the other depending upon state of subdivision and intimacy of admixture of the reactants. Under favourable conditions, reaction (2) may be driven to completion with almost total absence of reaction (3). Reaction (4) progresses with appreciable speed at temperatures over approximately $1000^\circ C$. Activated cathodes of BaO on W will have an interface of Ba_3WO_6 formed by reactions (2) or (4), or both, unless unusual precautions are taken to avoid this. The end result of heating the cathode is the conversion of the entire thickness of the oxide coating to the basic tungstate. The resulting coating of Ba_3WO_6 on W is unreactive and nonvolatile at temperatures up to $1300^\circ C$, and provides no significant thermionic emission.

A.

537.583

6598. Physica processes in the L cathode. D. L. SCHAEFER AND J. E. WHITE. *J. Appl. Phys.*, **23**, 669-73 (June, 1952).

The activity of this barium-on-tungsten cathode is maintained by dispensing barium from a pellet of barium compound. The dispensing mechanism is shown to be controlled by surface diffusion of barium over tungsten. Despite incomplete coverage of the emitting surface with barium, and almost complete absence of streaming of active material out through pores in the surface material, evaporation of barium is sufficient to be of concern in certain applications.

A.

537.583 : 621.385.032.21

6599. Efficiency of thermal electron emission. M. J. O. STRUTT. *Proc. Inst. Radio Engrs*, **40**, 601-3 (May, 1952).

The efficiency of thermal electron emission is defined as the total motional power imparted to emitted electrons over the total heating power of a cathode. Assuming that power loss is by radiation only, this efficiency is calculated theoretically and its optional value determined. Theoretical results are compared with practical values, and hints are given pointing to obtaining a better efficiency.

A.

COSMIC RAYS 537.591

537.591 : 550.385 : 538.566.3 : 523.75

The chromospheric eruption of November 19, 1949, and its geophysical consequences. See Abstr. 6252

537.591.08

6600. The electronic circuits of a "telescope" for studying the production and scattering of penetrating, ionizing particles from cosmic radiation. R. FAVRE. *Helv. Phys. Acta*, **24**, 599–602 (No. 6, 1951) In French.

The paper describes a method of using neon lamps to indicate which Geiger counters from groups in coincidence have been triggered. The neon lamps have applied across them a potential which is a few volts below their striking potential. A pulse from the counter (via its amplifier valve) then causes the neon lamp to strike. To safeguard against unwanted pulses being counted the neon lamp and the amplifier valve are normally "held off" by suitable potentials and are sensitized by pulses from a circuit actuated by the primary event being studied. Full details of the circuits and the advantages of this method are given.

L. E. MUSSELL

537.591.1

6601. The increase of ionization with momentum for energetic cosmic-ray particles. J. BECKER, P. CHANSON, E. NAGEOTTE, P. TREILLE, B. T. PRICE AND P. ROTHWELL. *Proc. Phys. Soc. [Lond.] A*, **65**, 437–48 (June, 1952).

An experiment is described in which the momentum and specific ionization of cosmic-ray mesons were simultaneously measured, the momentum by means of a cloud chamber in a magnetic field, and the specific ionization by rectangular proportional counters. The difficulties inherent in the use of proportional counters for such measurements are discussed. The experimental results are in satisfactory agreement with theoretical predictions of an increase of specific ionization for very energetic μ -mesons. A.

537.591.1

6602. Analysis of the nucleonic component based on neutron latitude variations. S. B. TREIMAN. *Phys. Rev.*, **86**, 917–23 (June 15, 1952).

A "specific yield" function $S_A(E, x)$ is defined which gives the production rate of disintegration neutrons at atmospheric depth x arising from a unit flux of vertically incident cosmic-ray primaries of atomic weight A and energy-per-nucleon E . The functions are obtained by comparing the latitude variations for the primary particle fluxes with the latitude variations for neutron production at various depths in the atmosphere. For atmospheric depths between at least 200 and 600 g/cm², it is found that specific yields increase rapidly with energy up to about 4-BeV/nucleon and then become insensitive to energy up to at least 12.7-BeV/nucleon. It is also shown that this insensitivity probably extends up to considerably larger energies. The theoretical implications of these results are qualitatively discussed. A.

537.591.1

6603. Momentum spectra of cosmic-ray mesons and protons at sea level and 3.4-km altitude. W. L. WHITTEMORE AND R. P. SHUTT. *Phys. Rev.*, **86**, 940–5 (June 15, 1952).

A cloud-chamber experiment has been performed at

sea level and 3.4-km altitude to collect data on the momentum and scattering distributions of 15 000 mesons and protons. The momentum spectra and derived conclusions are discussed here. The meson momentum distribution at sea level is in accord with the results of others. A comparison of the sea-level altitude spectra indicates that, for moments between 0.7 and 3 BeV/c, 0 to 15% of the mesons observed at sea level are produced below 3.4 km. Assuming that production of the fast mesons observed takes place within the top 125 g/cm² of the atmosphere, the differential momentum distribution of mesons at production can be represented adequately as an inverse power law with an exponent equal to 2.75 ± 0.07 , in good agreement with previous published results. The relative numbers of positive and negative particles at sea level agree well with those of other workers. At altitude the $+/-$ ratio becomes quite large for the lower momenta (up to 2.5 as against 1.2 at sea level), while it approaches the sea-level ratio (1.3) for high momenta. Assuming that the difference between the sea-level and altitude ratios is due to protons, one can compute that above 0.3 BeV/c protons form $19 \pm 2\%$ of all ionizing particles (excluding electrons) at 3.4 km. From the observed $+/-$ ratios the proton momentum spectrum has been calculated. A.

537.591.1 : 539.18

On the existence of "varitrons." See Abstr. 6771–3

537.591.15

6604. Investigation of the meson component of the electronic and nuclear showers by the method of the "delayed coincidences." A. ABDULLAEV, G. ZHDANOV, L. KORABLEV AND A. KHAIDAROV. Letter in *Zh. Eksper. Teor. Fiz.*, **21**, 1079–80 (No. 9, 1951) In Russian.

The authors describe in general terms the improvements in the method of delayed coincidences which they introduced in their apparatus for the investigation of the showers, produced by cosmic rays. Their aim was to separate more accurately and reliably the records of the particles appearing as a result of the nuclear disintegrations and ionizations caused by the incoming particles from the direct records of the latter. N. S. JAPOLSKY

537.591.15

6605. On the existence of Rossi second and third maxima of cosmic-rays. P. K. S. CHAUDHURY. *Indian J. Phys.*, **25**, 539–54 (Nov., 1951).

The controversial existence of Rossi second and third maxima of cosmic-rays were investigated in lead with a triple coincidence arrangements of counters under different geometrical conditions, and definite evidence obtained of the existence of a second maximum at about 18 cm of lead and a third maximum at about 23 cm of lead. Except for a drop of coincidence frequency at about 20 cm, both these maxima might be considered as a single flat maximum from 16 to 24 cm, similar to the results reported by Schopper and others. From a careful analysis of all the investigations made by other workers, it seems to the author that the failure of some workers to confirm the existence of these higher maxima may be due to (a) overlapping by oblique showers when all the counters are placed very near the absorber and (b) much greater percentage of side showers of external

and internal origin when all the three counters without appreciable vertical separation are placed too far below the absorber for narrow angle showers. An ideal arrangement, as follows from this investigation, is that one of the counters should be placed immediately below the absorber and the two others as far below the absorber as possible. For the interpretation of the origin of these higher maxima, it seems from their correspondence with anomalies in RaC γ -rays absorption in lead reported by the author [Abstr. 2920 (1948), 4956 (1949), 4501 (1951)] that either there are some residual photons in RaC γ -rays and in cosmic-rays which do not obey the current theories of photon interaction, and behave like an unstable neutrino, or that some such radiations are produced by photons in lead. Further, from the fact that RaC γ -rays are of maximum energy only 2.4 MeV, the author suggested that the new type of penetrating radiation may simply be a positron-electron dipole behaving as a neutral electro-meson before annihilation, or being dissociated back to a positron and electron by a Philips-Oppenheimer process. From energy consideration and the position of the third maximum, it follows that such a dipole may have a maximum life of the order of 10^{-9} sec only.

A.

537.591.15

6606. Associated pairs of particles in cosmic ray showers in photographic emulsions. J. Y. MEI AND E. PICKUP. Letter in *Phys. Rev.*, **86**, 796 (June 1, 1952).

Seventy-seven showers associated with stars in nuclear emulsions exposed at 85 000 ft have been examined for close pairs of tracks. The number observed is greater than would be expected by chance and possible interpretations are briefly discussed.

H. ELLIOT

537.591.15

6607. Numerical work on the fluctuation problem in cascade shower theory. J. W. GARDNER AND H. MESSEL. Letter in *Phys. Rev.*, **86**, 808 (June 1, 1952).

Outlines a proposed programme using an electronic computer at the University of Toronto.

H. ELLIOT

537.591.15

6608. The solution of the fluctuation problem in electron-photon shower theory. H. MESSEL AND R. B. POTTS. *Phys. Rev.*, **86**, 847-51 (June 15, 1952).

The analytical solution is given for the fluctuation problem arising in electron-photon shower theory under approximation A. The diffusion equations for two fundamental distribution functions are derived, and by transforming them into matrix recurrence relations their solution is obtained directly. From one of these distribution functions follows the analytical solution for the (n, m) th moments. The method of solution is similar to that previously employed by Messel and Potts to solve the fluctuation problems in nucleon shower theory. The G -equations used by Jánossy and Scott play no role in the solution of the problem.

A.

537.591.15

6609. The solution of the fluctuation problem in nucleon cascade theory: homogeneous nuclear matter. H. MESSEL. *Proc. Phys. Soc. [Lond.] A*, **65**, 465-72 (July, 1952).

Solutions are presented for the general number dis-

tribution function in cascade theory and for the k th moments of the distribution. The Jánossy G -equation is solved. The methods of solution developed are applicable to the similar problem in the electron-photon case.

A.

537.591.15

6610. The solution of the fluctuation problem in a finite absorber for nucleon cascades. H. MESSEL AND R. B. POTTS. *Proc. Phys. Soc. [Lond.] A*, **65**, 473-80 (July, 1952).

The complete analytical solution of the fluctuation problem for nucleon cascades developing in a finite absorber is given. Expressions are obtained for the general number distribution function and for the n th moments.

A.

537.591.15

6611. A comparison of penetrating showers in light and heavy elements. I. W. D. WALKER, N. M. DULLER AND J. D. SORRELS. *Phys. Rev.*, **86**, 865-9 (June 15, 1952).

A comparison of the multiplicity of penetrating particles has been made for penetrating showers originating in C and Pb, and for showers starting in Fe and paraffin. The comparison is made by observing the rates of different sized showers per mean free path of the generating material. Large differences are found in the comparison of Pb and C. The comparison of Fe and paraffin essentially gives a comparison of Fe and C as the showers originating in hydrogen were not recorded efficiently. The difference between showers starting in Fe and C is smaller than in the comparison of Pb and C. The ratio of neutral to charged primaries is determined to be 0.5 ± 0.15 . The collision mean free path of charged primaries in

paraffin is measured to be 56^{+12}_{-7} g/cm², and the

mean free path of charged primaries in carbon is measured to be 76 ± 8 g/cm². A search was made for elastic scatterings of penetrating shower primary particles in which only a small amount of energy is transferred to a target nucleon. Only one example of such scattering was observed in the traversal of 11 960 g/cm² of carbon.

A.

537.591.5

6612. On the east west asymmetry of the hard component of cosmic rays. B. BHOWMIK AND G. S. BAJWA. *Indian J. Phys.*, **25**, 561-4 (Dec., 1951).

Asymmetry has been measured at Delhi ($\lambda = 19^\circ$, height 700 feet) with two telescopes of angular resolution 10° in the vertical plane and 38° in the complementary plane. The soft component was filtered out by using 10 cm of lead. Errors due to fluctuation and relative inefficiency of the counting system were minimized by frequently exchanging the position of the telescopes with a special arrangement. The asymmetry rises to a maximum of 13% at zenith angle 40° and falls off at higher angles.

A.

537.591.5

6613. On the angular distribution and east-west asymmetry of the cosmic-ray intensity measured in nuclear emulsions. M. MORAND AND TSAI-CHÜ. *C.R. Acad. Sci. [Paris]* **234**, 1875-7 (May 5, 1952) *In French*. Measurements made at geomagnetic latitude $25^\circ 30' N$ and altitude 1400 m. Results are in good agreement with counter measurements.

H. ELLIOT

537.591.8

6614. Possible influence of κ -mesons on the underground cosmic radiation. L. VERLET. Letter in *Phys. Rev.*, **86**, 792 (June 1, 1952).

The temperature coefficient of the μ -meson intensity underground is calculated on the assumption that the μ -mesons are produced partly by the decay of π -mesons and partly by the decay of κ -mesons.

H. ELLIOT

MAGNETISM 538

538.114

6615. The spherical model of a ferromagnet. T. H. BERLIN AND M. KAC. *Phys. Rev.*, **86**, 821–35 (June 15, 1952).

A mathematical model, the spherical model, of a ferromagnet is described. The model is a generalization of the Ising model; and one, two and three-dimensional lattices of infinite extent can be extensively discussed. A three-dimensional lattice shows ferromagnetic behaviour and provides a statistical model of the Weiss phenomenological theory. The limiting free energy appears in a form which contains two of the essential features of the exactly known Ising model results in one and two dimensions. This suggests the probable form of the limiting free energy for the three dimensional Ising model. A simplified model is briefly discussed because this model also contains some of the significant features of the Ising model. However, the Gaussian model, unlike the spherical mode, is not defined for all temperatures. A.

538.114

6616. Molecular field treatment of ferromagnetism and antiferromagnetism. J. S. SMART. *Phys. Rev.*, **86**, 968–73 (June 15, 1952).

A modified Weiss treatment of magnetism in crystals which considers both first and second nearest neighbour interactions with all 4 combinations of signs was carried out. The usual results for ferromagnetism are obtained for both interactions positive. For the other cases, various types of magnetic ordering below the Curie temperature are predicted, the exact kind depending on the signs and magnitudes of γ_1 and γ_2 , the Weiss field coefficients for first and second nearest neighbour interactions, respectively. Explicit results are given for the kind of ordering as functions of θ/T_c for bcc and fcc lattices. Expressions are derived for the susceptibility of an antiferromagnet above and below the Curie temperature, the latter calculation being given for only a single axis of spontaneous magnetization only. The theory gives a good qualitative description of the behaviour of an antiferromagnet for all temperatures, although some of the detailed results are in disagreement with experiment. A.

538.114

6617. Antiferromagnetism by the spin wave method. I. The energy levels. J. M. ZIMAN. *Proc. Phys. Soc. [Lond.] A*, **65**, 540–7 (July, 1952).

The Hamiltonian operator for an exchange antiferromagnet is expressed in terms of the deviations of the spins from the basic ordered antiparallel arrangement. By a Fourier transformation the

Hamiltonian may be approximately represented as a sum of harmonic oscillator terms, corresponding to spin waves. The role of anisotropy energy in fixing the domain axis is discussed, and the energy levels are calculated for the case of an external field parallel to this axis. The ground-state energy includes the zero-point energy of the spin waves and is in good agreement with other theories. Formulae are quoted for a Hamiltonian including dipole-dipole interaction between non-isotropic spins. A.

538.114

6618. Antiferromagnetism by the spin wave method. II. Magnetic properties. J. M. ZIMAN. *Proc. Phys. Soc. [Lond.] A*, **65**, 548–56 (July, 1952).

From the energy levels obtained in Pt I the partition function and magnetic susceptibilities are calculated. $\chi_{||}$ behaves like aT^2 at low temperatures, whilst $\chi_{\perp}$ is constant. The magnetic resonance absorption frequencies are also calculated and shown to depend strongly on the anisotropy field. By representing the true Hamiltonian in terms of the operators of the approximate Hamiltonian, correction is made for the disordering of the system by the spin waves, and susceptibility curves agreeing well with experiment can be calculated. The method is applicable to different types of lattice and of interaction, is not confined to zero fields, and is valid up to near the critical temperature. A.

538.22

6619. Isolated and adiabatic susceptibilities. M. J. KLEIN. Letter in *Phys. Rev.*, **86**, 807 (June 1, 1952).

A necessary and sufficient condition for the equality of the two susceptibilities is established, and it is shown that the isolated susceptibility has meaning only under somewhat severe restrictions. L. PINCHERLE

538.221

6620. Investigation of an iron-nickel strip under slight tension in steady or alternating fields. I. EPELBOIN AND G. GILARDIN. *C.R. Acad. Sci. [Paris]* **234**, 1860–2 (May 5, 1952) *In French*.

Measurements in the Rayleigh region on a mumetal strip show that the static and dynamic permeabilities are here identical and that the magnetic texture (variation of initial permeability across the width of the strip) is also the same in the two cases. The influence of tension on texture is only slight and it is suggested that this is mainly due to anisotropy effects.

E. P. WOHLFARTH

538.221

6621. Ferromagnetic resonance in manganese antimonide. G. D. ADAM AND A. K. STANDLEY. Letter in *Proc. Phys. Soc. [Lond.] B*, **65**, 454–5 (June, 1952).

Recent measurements between 20°C and the Curie point at a wavelength 1.26 cm. The half width decreases from 5000 to 1100 oersted and the g value from 2.75 to 2.1 as the temperature is raised. The variation of g may be due to the change of the anisotropy constant with temperature. E. P. WOHLFARTH

538.221

6622. Low remanence and the temperature variation of the permeability of silicon-iron alloys. E. W. LEE. Letter in *Proc. Phys. Soc. [Lond.] B*, **65**, 455–6. (June, 1952).

Ascribes low remanence values and negative temperature coefficients of permeability jointly to

internal flux closure effects, due to the domain wall energy being small enough to allow the alloy to demagnetize itself by formation of new boundaries subsequent to removal of the applied field or even in the presence of a small applied field [see Bozorth, *Z. Phys.*, **124**, 519 (1947)].

E. P. WOHLFARTH

538.221

6623. Ferromagnetic resonance in nickel ferrite as a function of temperature. D. W. HEALY, JR. *Phys. Rev.*, **86**, 1009–13 (June 15, 1952).

Ferromagnetic resonance in NiOFe_2O_3 has been studied over a temperature range of -195°C to 588°C . From this study the variation in line width with temperature, g value, and magnetic anisotropy constants K_1 and K_2 have been determined. Results show that the line width decreases with increasing temperature, the g value remains essentially constant, and the two anisotropy constants show different sign behaviour over the temperature range.

A. 538.221 : 538.562

6624. Temperature variation of the magnetostriction of "Alcomax." M. McCAIG. Letter in *Nature [Lond.]* **169**, 889–90 (May 24, 1952).

Gives curves showing the variation for temperatures between 0° and 800°C of the magnetostriction of Alcomax III and Ticonal.

E. P. WOHLFARTH

538.221 : 538.662.15

6625. Thermomagnetic investigation of a [natural] single crystal of $\alpha\text{Fe}_2\text{O}_3$. L. NÉEL AND R. PAUTHENET. *C.R. Acad. Sci. [Paris]* **234**, 2172–4 (May 26, 1952) *In French*.

Describes measurements of the saturation magnetization σ as a function of field and temperature (20° – 950°K) and gives curves of σ_0 and χ , where $\sigma = \sigma_0 + \chi H$ for $H > 10^4$ oersted. Both σ_0 and χ vary abnormally with temperature near 250°K . The variation of χ is thought to be due to antiferromagnetic behaviour, the direction of antiferromagnetism being perpendicular to the basal plane of the crystal below 250°K and parallel to it above. The variation of σ_0 is explained by postulating weak superimposed ferrimagnetism.

E. P. WOHLFARTH

538.221 : 621.318.1

6626. Ferromagnetic properties of metals and alloys. K. HOSELITZ. *Oxford, Clarendon Press* (1952) 330 pp.

A comprehensive account of present-day theories of the magnetization curve, and an attempt to demonstrate the connection between properties obtained in practice and existing theoretical explanations. The composition and properties of soft magnetic materials, as well as those of magnetically hard alloys, are fully described. A further section deals with methods of magnetic analysis for the determination of the constitution and structure of ferromagnetic metals and alloys. The potential application of magnetic methods to metallurgical problems is indicated. The book is intended for post-graduate and industrial research workers in physics, metallurgy and electrical engineering.

538.221 : 621.318.12

6627. Hexagonal iron oxide powders as permanent magnet materials. J. J. WENT, G. W. RATHENAU, E. W. GORTER AND G. W. VAN OOSTERHOUT. Letter in *Phys. Rev.*, **86**, 424 (May 1, 1952).

A résumé of an earlier paper [Abstr. 5900 (1952)].

The oxides have the formulae $\text{BaO} \cdot 6\text{Fe}_2\text{O}_3$ and $\text{BaO} \cdot 2\text{Fe}_3\text{O}_4 \cdot 6\text{Fe}_2\text{O}_3$. Magnetic properties above and below the Curie point indicate that the oxides are ferrimagnetic. They have hexagonal structure with strong magnetocrystalline anisotropy. The coercivity is very large, $1H_c$ reaching a maximum of about 4700 oersted at 250°C for the first-named oxide. The energy product of this oxide is about 0.85×10^6 at $B = 1100$ gauss. The specific resistivity is very high, about 10^7 ohm cm at room temp. The reasons for the unusual properties of the oxides are briefly discussed.

E. P. WOHLFARTH

538.222

6628. Paramagnetism of iron sulphides. R. BENOÎT. *C.R. Acad. Sci. [Paris]* **234**, 2174–5 (May 24, 1952) *In French*.

Describes measurements on FeS_n ($n = 1.0, 1.15$) between 0 and 1000°C . For $n = 1.0$ antiferromagnetic behaviour is observed with a Néel temperature 340°C above which the Curie–Weiss law is obeyed with $C_M = 3.44$. For $n = 1.15$ ferrimagnetic behaviour is observed with a Curie temperature 292°C , but the susceptibility decreases very rapidly near 550°C , possibly due to structural changes which cause this sulphide also to become antiferromagnetic.

E. P. WOHLFARTH

538.222

6629. The paramagnetic susceptibility of AuFe alloys. E. KRONQVIST. *Ark. Fys.*, **5**, 453–8 (Paper 21, 1952).

Describes measurements for alloys with iron concentrations up to 22% atomic and temperatures up to 1000°K to supplement earlier work by Kaufmann *et al.* [Abstr. 533 (1946)]. The $1/\chi$, T curves become linear at the higher temperatures and the p_B value is found to be about 4.1 per iron atom, independently of the Fe concentration.

E. P. WOHLFARTH

538.224

6630. The behaviour of dispersions in a magnetic field. O. TANAIEVSKY. *C.R. Acad. Sci. [Paris]* **234**, 2067–9 (May 19, 1952) *In French*.

The specific diamagnetic susceptibilities of colloidal SnO_2 and HgO in aqueous media increase with decreasing particle size but no such variation is observed with colloidal Ag , Ag_2S , Hg , ZnS and CdS .

G. I. W. LLEWELYN

538.224

6631. Investigation of the magnetic properties of diamagnetic colloidal dispersions. A. PACAULT. *C.R. Acad. Sci. [Paris]* **234**, 2169–71 (May 26, 1952) *In French*.

Gives formulae for $(\chi_3 - \bar{\chi})/(\chi_3 - \chi_1)$ as a function of $u = \{mH^2(\chi_3 - \chi_1)/kT\}^{1/2}$ for prolate and oblate spheroids of mass m , principal susceptibilities χ_1 , χ_3 , χ_2 and mean susceptibility $\bar{\chi}$ and gives a partial experimental verification for colloidal particles of low crystal symmetry (S , SnO_2 , HgO , As_2O_3) for which u may be related to particle size.

E. P. WOHLFARTH

538.23

6632. The influence of heat treatment on magnetic viscosity in permanent magnet alloys. R. STREET, J. C. WOOLLEY AND P. B. SMITH. Letter in *Proc. Phys. Soc. [Lond.] B*, **65**, 461–2 (June, 1952).

The magnetic viscosity of Alnico is a unique

function of the heat treatment, while identical coercivity values are obtainable by differing types of treatment. Curves are given of S , where $\Delta I = I - SI_{\text{int}}$, as a function of H , for two differing types of treatment, cooling at different rates from 1250°C and annealing for various times at 700°C after water quenching.

E. P. WOHLFARTH

538.23 : 538.653

6633. Comparison of magnetoelastic energy losses and magnetic hysteresis in ferromagnetic materials. J. BONFIGLIOLI, A. FERRO AND G. MONTALENTI. *Phys. Rev.*, **86**, 959-60 (June 15, 1952).

In the present work it is shown that in several samples of ferromagnetic materials, with medium coercive forces, magnetic hysteresis energy losses in a saturation loop are higher than, but of the same order as, magnetoelastic energy losses in a stress cycle described between values of stress not far from the yield point. Moreover, it is observed that the law that expresses the magnetoelastic energy loss of a stress loop as a function of the difference between maximum remanence $J_r(\tau)$ (measured at the maximum value of stress) and the initial value $J_r(0)$ (measured on material at rest) is of the type $E = K[\Delta J_r(\tau)]^n$, where E is the energy loss and n is an exponent comprised between 1.2 and 2.2. This law is very similar to the Steinmetz law, with the value of ΔJ , substituted for the value of J (intrinsic induction at the tip of a magnetic loop).

A.

538.245 : 538.54

6634. On micro-eddy-currents occurring at the displacement of boundaries between domains. N. S. AKULOV AND G. S. KRINCHIK. *Dokl. Akad. Nauk SSSR*, **81**, 171-4 (No. 2, 1951) In Russian.

ELECTROMAGNETISM . ELECTRODYNAMICS 538.3/5

538.55 : 621.3.012.8

6635. Equivalences for the analysis of circuits with small nonlinearities. W. J. CUNNINGHAM. *J. Appl. Phys.*, **23**, 653-7 (June, 1952).

Equivalent forms may be useful in the analysis of the steady-state operation of circuits containing a non-linear resistance element. Provided the amount of non-linearity is not too large, the non-linear element can be replaced by a linear resistance and several generators of voltage or current. The amplitude, phase and frequency of these generators are determined by the nature of the non-linearity and by the fundamental component of current in the non-linear element.

A.

538.55 : 621.317.715 : 621.317.31.088

6636. Calculation of the error in the reading of a moving-coil galvanometer traversed by a current of variable intensity. R. LEGROS. *Ann. Phys. [Paris]* **7**, 83-316 (March-April, 1952) In French.

A theoretical investigation, considering cases where the current varies with time, with damping varying from nil to more than critical, and a range of periodic times. Families of curves are given, with tables of

corresponding values of constants. In general it is found in these cases that the error is small when the damping is small, but when the time of discharge is long the error is smaller with critical damping.

E. H. W. BANNER

ELECTROMAGNETIC WAVES AND OSCILLATORS 538.56

538.56 : 621.3.013

6637. On electric fields in a number of contiguous media of different dielectric constants. J.-I. TAKAGI. *Mem. Fac. Sci. Engng Waseda Univ.*, No. 14, 45-6 (1950).

A short note outlining the treatment of 2-dimensional problems using quasi-analytic functions and conformal transformations.

538.565 : 551.594.221 : 551.594.6 : 621.396.822

Some observations on the frequency spectrum of atmospheric disturbances. See Abstr. 6944

538.565 : 621.392.2

6638. The radiation resistance of resonant transmission lines. R. A. CHIPMAN, E. F. CARR, N. A. HOY AND M. YURKO. *J. Appl. Phys.*, **23**, 613-20 (June, 1952).

For resonant sections of a transmission line consisting of parallel silver rods extending vertically above a metal ground plane, the resonance curves of input admittance as a function of line length have been drawn by a synchronized recording meter apparatus, and the effective total resistance of each resonant line calculated. This has been done for frequencies between 300 Mc/s and 1400 Mc/s, for resonant line lengths up to several wavelengths, for line sections with both open-circuit and short-circuit termination at the top, and in each case with and without a large metal pipe shielding the test line. Radiation resistance is obtained as the difference between the resistance calculations for any one resonant line section unshielded and shielded. With a probable error of about 5% the radiation resistance is found to be proportional to the square of the frequency, and to be independent of line length and of whether the top termination is an open circuit or a short circuit. The absolute values agree reasonably well with the theory of Storer and King [*Proc. Inst. Radio Engrs*, **39**, 1408 (1951); Abstr. 1283 B(1952)] and disagree conclusively with some predictions of earlier theories.

A.

538.565 : 621.396.11 : 621.317.76.029.6

6639. An airborne microwave refractometer. C. M. CRAIN AND A. P. DEAM. *Rev. Sci. Instrum.*, **23**, 149-51 (April, 1952).

A device for measuring directly tropospheric index of refraction fluctuations and profiles is described. The change in resonant frequency of a cavity resonator exposed to atmospheric air is recorded continuously—thus giving a continuous recording of atmospheric index of refraction relative to an arbitrary reference. The method used for sampling the air and the

measured errors involved are described. A typical segment of recorded data is shown. A.

538.566

6640. Huygens' principle in diffraction problems. J. P. SCHOUTEN AND A. T. DE HOOP. *Tijdschr. Ned. Radiogenoot.*, 17, 45–62 (March, 1952) In Dutch.

Following a method given by A. G. Clavier (1948) Huygens' principle for electromagnetic waves is derived directly from Maxwell's equations in fact without making use of fictitious magnetic charge and current densities. After establishing different forms of Huygens' principle it is shown that if the surface S over which the integrals have to be extended degenerates into an infinite plane, the obtained expressions are equivalent to those made plausible by W. R. Smythe (1947). A.

538.566 : 621.396.11 : 621.392.2

6641. Electromagnetic reflection and transmission by gratings of resistive wires. E. A. LEWIS AND J. P. CASEY, JR. *J. Appl. Phys.*, 23, 605–8 (June, 1952).

Calculations show that the effect of increasing the resistivity of the wires is to decrease the amplitude of the reflection coefficient and the phase of the transmission coefficient. The sign of the changes in the amplitude of the transmission coefficient and the phase of the reflection coefficient depends upon the amplitude of the reflection coefficient of a geometrically similar grating having no resistance. A numerical example for a typical grating is worked out and several charts are supplied for convenience in computing. A.

538.566 : 621.396.671 : 621.3.014.1

6642. On the current induced in a conducting ribbon by the incidence of a plane electromagnetic wave. E. B. MOULLIN AND F. M. PHILLIPS. *Proc. Instn. Elect. Engrs., Pt IV*, 99, 137–50 (July, 1952) [Monogr. No. 26]. For abstract see Abstr. 3733 (1952).

538.566 : 621.392.26

6643. Rigorous solution for the case of electromagnetic wave propagation along a circular wave guide of finite conductivity. K. V. K. PRASAD. *Indian J. Phys.*, 25, 417–22 (Sept., 1951).

The final solution can be grouped into two parts. One part which can easily be computed in practice has the form of the usual normal mode type solutions, but they are neither orthogonal nor a complete set. The other part, represented by contour integrals, cannot be so easily computed. In the case of metallic waveguides the contribution by the latter type of fields is indeed negligible, but they do have practical significance and contribute a major part in the case of waveguides of small conductivity. A.

538.566 : 621.392.26

6644. Faraday rotation of guided waves. H. SUHL AND L. R. WALKER. Letter in *Phys. Rev.*, 86, 122–3 (April 1, 1952).

Natural modes of propagation in a guide filled with different media have been established. The modes, which are circularly polarized, are never purely transverse electric or magnetic and are classified according to whether their limits as $H_0 \rightarrow 0$ are T.E. or T.M. Z. F. WOJNAR

538.566 : 621.396.61 : 621.317.34

6645. Methods of measuring extra-band radiation from radio transmitters. N. LUND. *U.R.S.I. Proc. IXth Gen. Assembl.*, 8, 302–9 (Pt II, 1950).

Discussion of 3 possible methods differing in the type of signal modulating the transmitter: (a) two tones of equal amplitude, (b) normal speech signal, (c) thermal noise of equivalent bandwidth and amplitude. Results are presented. It appears that method (c) is particularly valuable. G. M. BROWN

538.566.2 : 621.317.34

6646. The present status of the problem of noise measurement. C. C. CHAMBERS. *U.R.S.I. Proc. IXth Gen. Assembl.*, 8, 310–14 (Pt II, 1950).

538.566.2 : 621.317.34 : 621.396.822

6647. Discussion relative to radio noise. H. O. PETERSON. *U.R.S.I. Proc. IXth Gen. Assembl.*, 8, 289–91 (Pt II, 1950).

Measurements of radio noise on frequencies from 16 to 30 kc/s by determining the field strength required to operate a receiving printing telegraph machine so as to produce 10 mutilated characters per 1000 transmitted from a local signal generator. It is found that field strength is $\propto$ (frequency) $^{-3.9}$; also peak amplitudes of stronger atmospheric pulses are $\propto$ effective bandwidth of the receiver. G. M. BROWN

538.566.2 : 621.396.11

6648. Long-range propagation of short radio waves by atmospheric scattering. E. C. S. MEGAW. *U.R.S.I. Proc. IXth Gen. Assembl.*, 8, 134–46 (Pt II, 1950).

Summary article, with full bibliography, concerning the propagation of cm-waves beyond the horizon. The field strengths observed are too large to be explicable as a diffraction effect. They are accounted for in terms of a scattering process in the atmosphere resulting from its permanent turbulent state and consequent fluctuation of refractive index [cf. stellar scintillation; see Abstr. 2219 (1951)]. Experimental results for 10 cm waves are considered and it is shown that turbulent scattering is not greatly dependent on time or place. G. M. BROWN

538.566.2 : 621.396.11

6649. Propagation of metre-waves for short distances near the ground. G. BERTAUX AND R. PRIEUR. *U.R.S.I. Proc. IXth Gen. Assembl.*, 8, 175–6 (Pt II, 1950) In French.

Short note describing results of experiments on propagation of waves of lengths between 3 and 12½ m over distances < 10 km using various heights of receiving aerials. Good agreement with theory is found for open country, while signal strengths are very variable for wooded country. Above the ground the signal appears almost independent of the conductivity and wavelength, but varies as (permittivity) $^{1/2}$. G. M. BROWN

538.566.2 : 621.396.11

6650. Over-land refraction of high-frequency radio waves in India. K. R. SAHA. *Indian J. Phys.*, 25, 437–50 (Sept., 1951).

From a study of the vertical distribution of the mean modified refractive index (m.r.i.) of the lowest kilometre of the atmosphere over three land stations

computed from routine aeroplane flight and radio-sonde reports, conclusions are drawn regarding radio propagation conditions over these stations at some selected hours of the day and in different months of the year. While combined effects of temperature inversion and humidity lapse with height explain super-refraction at these stations on most occasions, some cases of super-refraction are observed with lapse rates in both temperature and humidity. Meteorological origin of the mean m.r.i. profiles is discussed. A.

538.566.2 : 621.396.11

6651. An integral equation approach to the problem of wave propagation over an irregular surface. G. A. HUFFORD. *Quart. Appl. Math.*, **9**, 391-404 (Jan., 1952).

An approximate technique for solving the wave equation subject to certain simplifying assumptions is given. The analysis finds application in the transmission of h.f. radio waves over irregularities in the earth's surface. W. J. G. BEYNON

538.566.2 : 621.396.11

6652. Average radio-ray refraction in the lower atmosphere. M. SCHULKIN. *Proc. Inst. Radio Engrs*, **10**, 554-61 (May, 1952).

Existing corrections for atmospheric refraction in radio-field intensity computations are reviewed with respect to their application to computation of ray bending. A practical scheme is presented for calculating atmospheric refraction of r.f. rays numerically from radiosonde data. Ray-bending computations are made for a range of climatological conditions for rays passing entirely through the atmosphere and arriving or departing tangentially at the earth's surface. Some discussion is included on the uncertainty in refractive-index computations from meteorological sounding data. A.

538.566.2 : 621.396.11

6653. Resonance in gyro-interaction of radio waves. V. A. BAILEY, R. A. SMITH, K. LANDECKER, A. J. HIGGS AND F. H. HIBBERD. *Nature [Lond.]* **169**, 911-13 (May 31, 1952).

Account of series of experiments carried out in Australia to investigate the resonance occurring when a low-power modulated wave ("gyro wave") impresses its modulation on a second sky wave reflected in its neighbourhood ("wanted wave") as the frequency of the gyro wave passes through the local gyro-frequency. The shapes of the resonance curves confirm all the theoretical predictions, and it is suggested that the method may be used for a detailed investigation of the lower part of the E-layer, e.g. magnetic field, collisional frequency, temperature, electron density gradient. G. M. BROWN

538.566.2 : 621.396.812.3 : 621.396.11

6654. Signal fluctuations on long range over water propagation. W. S. AMENT AND M. KATZIN. *U.R.S.I. Proc. IXth Gen. Assembl.*, **8**, 147-51 (Pt II, 1950).

Measurements in 1946 of the propagation over the Pacific Ocean of 9 cm and 3 cm waves transmitted from an aeroplane flying at various altitudes. Interference between the direct wave and that reflected by the ocean is observed up to the horizon, beyond

which is an "exponential" region in which the attenuation conforms to theory. On 9 cm, but not 3 cm, there is a "turbulent" region some 30 miles beyond the horizon in which the received signal shows rapid fading and reduced attenuation, believed to be caused by scattering centres high over the ocean.

G. M. BROWN

538.566.3 : 550.385 : 537.591 : 523.75

The chromospheric eruption of November 19, 1949, and its geophysical consequences. See Abstr. 6252

538.566.3 : 621.396.11

6655. The ionospheric propagation of radio waves of frequency 16 kc/s over distances of about 200 km. R. N. BRACEWELL. *Proc. Instn Elect. Engrs, Pt IV*, **99**, 217-28 (July, 1952) [Monogr. No. 34].

For abstract see Abstr. 4495 (1952).

538.567

6656. Possibility of frequency multiplication and wave amplification by means of some relativistic effects. K. LANDECKER. *Phys. Rev.*, **86**, 852-5 (June 15, 1952).

A method is proposed of converting the frequency of an electromagnetic wave to a higher frequency by reflection from an electron cloud moving with relativistic velocity. Such an electron cloud can be realized by compressing all or part of the electron beam of an electron accelerator into one or more groups. It is shown that there is a gain of wave energy arising from the relativistic law of reflection of a wave which is reflected from such a cloud. It is also shown on the basis of Bailey's relativistic electromagneto-ionic theory that under certain circumstances the reflection from a moving slab of electrons may be increased considerably if the slab moves through a longitudinal or transverse magnetic field. It is estimated that a wave of length 1 mm and of a power at least one milliwatt can be generated by reflecting a wave of length 3 cm from the beam of a small betatron. Equipment is being designed to test this prediction experimentally. A.

538.567.4 : 621.396.619

6657. On the distribution of energy in noise-and-signal modulated waves. I. Amplitude modulation. II. Simultaneous amplitude and angle modulation. D. MIDDLETON. *Quart. Appl. Math.*, **9**, 337-54 (Jan.); **10**, 35-56 (April, 1952).

Analysis of a carrier wave amplitude-modulated by normal random noise, or signal-and-noise, shows that the amplitude distortion characteristic of over-modulation spreads the spectrum but not significantly; the additional noise components are due to (noise $\times$ noise) noise modulation products. When a modulating signal accompanies the noise, distortion of the signal also occurs and (signal $\times$ noise) as well as (noise $\times$ noise) harmonics are produced. Expressions for mean total power, the mean carrier power, the mean continuum power, and the mean power in the discrete portions of the spectrum are given, together with a detailed treatment of the spectral distribution of the wave's energy. The second paper examines the case of a carrier which is simultaneously amplitude- and angle-modulated by a pair of normal random noise waves. Special attention is given to the example of coherent modulation without over-modulation. A. V. BREHME

MAGNETIC EFFECTS 538.6

538.63

6658. On galvanomagnetic properties of iron-nickel alloys in the region of the paraprocess. K. P. BELOV AND I. K. PANINA. *Zh. Eksper. Teor. Fiz.*, **21**, 809-13 (No. 7, 1951) In Russian.

538.639 : 548.0

6659. On the influence of the form on the resistance of monocrystals of bismuth in a magnetic field. E. S. BOROVNIK AND B. G. LAZAREV. *Zh. Eksper. Teor. Fiz.*, **21**, 857-63 (No. 8, 1951) In Russian.

538.652

6660. Magnetostrictive vibration of prolate spheroids. Ni-Fe and Ni-Cu alloys. J. S. KOUVELITES AND L. W. MCKEEHAN. *Phys. Rev.*, **86**, 898-904 (June 15, 1952).

The study of the different magnetic properties determined from the magnetostrictive vibrational behaviour of small ferromagnetic prolate spheroids was extended to a large number of Ni-Fe and Ni-Cu alloys. The computed values for the saturation magnetostriction, the total change of Young's modulus with magnetization, and the initial permeability of plain-annealed (i.e. annealed in zero magnetic field) specimens of these materials, were inserted in two independent expressions, derived by Kersten, for the internal stress. The agreement between the two sets of values was quite good. The Ni-Fe alloys were also studied after having been magnetic-annealed; moreover, the 68% Ni permalloy, having exceedingly strain-sensitive properties, was investigated in cold-worked, baked, and annealed conditions. In general, the changes of the calculated internal stress with heat treatment appeared consistent with the corresponding variations of properties such as the initial permeability. Even more revealing in this way were the values for the domain size determined from the computed dissipation factors and internal stresses and found to agree very well with previous measurements of Barkhausen discontinuities. When, for all the plain-annealed specimens, the relative change of Young's modulus was plotted against the relative magnetization, it was discovered that all the curves were almost identical. With the support of previous work it was concluded that these curves should be similar for all plain-annealed face-centred-cubic structures at room temperature. A.

538.652 : 669.14 : 621.314.2.042 : 621.318.13

6661. Magnetostriction in transformer steel. W. ALEXANDER AND J. SWAFFIELD. *Rep. Brit. Elect. Res. Ass., Ref. Q/T102*, 24 pp. (1943).

Summarizes the methods by which the minute movements associated with magnetostriction have been measured. Some details of the Joule effect in ferromagnetic metals are given, particular reference being made to the alloys of iron. A.

538.69 : 535.214

6662. Screwlike motion of steel particles under the influence of a magnetic field and an intense light beam. H. DANAN. *J. Phys. Radium*, **13**, 185-9 (April, 1952) In French.

Further experiments on the so-called Ehrenhaft

effect. In the helical motion of the particles (10^{-3} - 10^{-5} cm) the sense of rotation is independent of their electrical state. During changes of field strength analysis of photographs shows that the total kinetic energy of the particles remains constant.

E. P. WOHLFARTH

MOLECULAR AND ATOMIC STRUCTURE 539.1

THEORY OF SOLID STATE 539.11

539.111

6663. On the theory of binary alloys. I. L. APTEKAR AND B. H. FINKELSHTEIN. *Zh. Eksper. Teor. Fiz.*, **21**, 900-9 (No. 8, 1951) In Russian.

Solid solutions of the substitution type with isomorphous components are considered, not taking into account intermetallic compounds. The term for free energy is chosen by calculating the interaction of only the nearest neighbours. In difference to other theories the dependence of free energy on the lattice parameter is taken into account. The dependence of the lattice parameter on concentration for the series of alloys is described, and also investigations of some unique features of the processes of regulation and dissolution of solid solutions. N. GULLILAND

539.111

6664. The nature of chemical and metallic binding. T. G. OWE BERG. Letter in *J. Phys. Radium*, **13**, 245 (April, 1952) In French.

Analyses the values of the heats of formation of alkali and alkaline earth salts and shows that the ratio of the values for divalent metals divided by the values for monovalent metals in the same period is with a few exceptions close to 2. It is concluded that the potential of each binding electron is independently of the number of binding electrons. See also Abstr. 7069 (1951).

E. P. WOHLFARTH

539.111

6665. Energy bands and localized states in the perturbed Kronig potential. B. KOCKEL. *Z. Naturforsch.*, **7a**, 10-16 (Jan., 1952) In German.

Permitted electronic energy states in the nominally forbidden bands develop if the potential in one of the cells of the standard Kronig potential is raised or lowered. In the former case they lie above their respective permitted bands, in the latter they lie below the bands. The energy gap between the single state and the band is traced as a function of the perturbing potential. Remarks are made about the distortion of energy bands in general.

P. T. LANDSBERG

539.111

6666. Electronic bound states at the surface of a metal. G. R. BALDOCK. *Proc. Camb. Phil. Soc.*, **48**, 457-69 (Pt 3, 1952).

The conditions under which bound states associated

with atoms in the surface of a metal may exist are investigated, using the tight-binding approximation. These states arise as a result of modifications in the parameters of certain atoms. The modifications required to produce (a) bound states associated with all the atoms in the surface (surface states) and (b) bound states associated with particular small groups of atoms are found for the simple cubic lattice. It is also shown that most of the simpler crystal structures do not exhibit surface states without such modifications; in the graphite and diamond lattices, however, surface states exist solely by virtue of the lattice geometry. A.

539.11

6667. On the effective number of free electrons in aluminium. F. ABELÈS. Letter in *J. Phys. Radium*, **13**, 240-1 (April, 1952) In French.

The view that Al has three valence electrons in the metallic state, and that these behave like free electrons, is put forward. It is used to discuss the electrical resistance of alloys containing Al, the X-ray emission band, optical data, the thermal and electrical conductivities at low temperatures, and other experimental results. P. T. LANDSBERG

539.11

6668. Nuclear magnetic resonance of hydrogen absorbed into palladium wires. R. E. NORBERG. *Phys. Rev.*, **86**, 745-52 (June 1, 1952).

Steady-state absorption and pulsed "echo" experiments were performed. The wires were connected as circuit elements and the resonance signals observed were caused by protons contained in the skin layer of the wires. Samples were loaded by means of a glow discharge to concentrations from 0.2 to 0.8 (expressed as atom ratios H/Pd). Measurements were made, as a function of temperature and H concentration, of line width, T_1 , T_2 and resonance shifts. The results are interpreted to give information on the diffusion of the protons among the interstices of the Pd lattice and on the interaction of the protons with the conduction electrons. The observation of an asymmetric line shape for the absorption signal has led to a theory of a "lossy" resonance to be expected in metal wires. A.

MOLECULAR STRUCTURE 539.13

539.13 : 537.212

Determination of a single quadrupole for a charge distribution. See Abstr. 6482

539.132

6669. Overlap integrals and the linkage in complex ions. W. S. FYFE. Letter in *J. Chem. Phys.*, **20**, 1039-40 (June, 1952).

In view of the previously deduced relation between the free energy of formation of complex ions, formed from cations and anions or neutral atoms, and the ionization potential of the metal and the electron affinity of the ligand, the overlap integral of the bond should be a measure for the stability of the

complex. Overlap integrals are calculated for bonds between Li and several ligands, and also for H and Mg complexes. The order of stability thus calculated agrees well with experiment. The electronic distribution of a system is found to effect the stability considerably. A. J. TAYLOR

539.132

6670. Hydrogen bond energies in carboxylic acids. M. M. JONES, W. R. GILKERSON AND G. A. GALLUP. Letter in *J. Chem. Phys.*, **20**, 1048 (June, 1952).

Carbonyl and hydroxyl bonds are represented as classical dipoles with polarizability. The heat of dimerization, determined from the interaction energy, is in agreement with experiment, and suggests the "hydrogen bond" in carboxylic acids may be accounted for on the basis of intermolecular forces. H. H. GREENWOOD

539.132

6671. Interactions of closed shell ions. G. L. MONTET, S. P. KELLER AND J. E. MAYER. *J. Chem. Phys.*, **20**, 1057-63 (July, 1952).

Equations are written for the binding energy of a finite number of ions at fixed co-ordinate positions. Each ion is assumed to have a lowest non-degenerate (closed shell) configuration. In the Heitler-London approximation the state of the assembly is assumed to be: (a) a properly antisymmetrized sum of products of one-electron functions, and (b) the constituent one-electron functions are assumed to be linear combinations of only the one-electron functions composing the ground states of the isolated ions. For each ion a its density matrix, $\eta_a(q_i, q_j) = \sum \psi_{va}(q_i) \psi_{va}^*(q_j)$, is used, with q_i, q_j the co-ordinates, including spin, of a single electron, and the sum including all filled one-electron functions, ψ_{va} , of the ground state of ion a . The binding energy, consistent with the two assumptions (a) and (b) is then derived and found to be expressible in a reasonably compact exact form, using this density matrix. By making use of an approximate expression for the density matrix the integrations occurring in the energy expression are tractable. A.

539.132

6672. The interaction of normal and metastable helium atoms. R. A. BUCKINGHAM AND A. DALGARNO. *Proc. Roy. Soc. A*, **213**, 327-49 (July 8, 1952).

The energy of interaction of a normal He atom and one excited to the first triplet or singlet metastable state is calculated over a range of nuclear separations from a_0 to $12a_0$. The Heitler-London method is followed, with inclusion of all non-orthogonality integrals, and using analytic wave functions. Because of identity of the nuclei, g and u states of interaction occur, the energy of the u state having a minimum at about $2.1a_0$, and a positive maximum of 0.29 and 0.26 eV (for triplet and singlet states respectively) at about $4a_0$; the g state is entirely repulsive. Comparison is made with experimental evidence for the binding energy of normal and metastable (triplet) atoms. An estimate is made of the second-order dipole-dipole interaction for large separations, and it seems certain that the first-order interaction dominates at least to $12a_0$. Methods of calculating the necessary integrals are discussed. A.

539.132
6673. Vibrational intensities. II. The use of isotopes. B. CRAWFORD, JR. *J. Chem. Phys.*, **20**, 977–80 (June, 1952).

For Pt I, see Abstr. 8152 (1950); for Pt III, see Abstr. 2886 (1952). Two rules are presented which relate the intensities of vibrational fundamentals of different isotopic species. They are thus analogous to the Teller–Redlich product rule which relates frequencies. They apply to either infrared or Raman intensities. One rule permits the calculation of dipole-moment derivatives without the determination of normal co-ordinates. The application of the rules is illustrated. A.

539.132
6674. Additional intensity rules for isotopic molecules. J. C. DECIUS. Letter in *J. Chem. Phys.*, **20**, 1039 (June, 1952).

In cases where the symmetry species of the isotopic molecules does not include a rotation, and/or the molecule is non-polar, a simple relation holds between the intensity sums. J. JACOBS

539.132
6675. Rotation of the ammonium ion in the high temperature phase of ammonium iodide. C. C. STEPHENSON, L. A. LANDERS AND A. G. COLE. Letter in *J. Chem. Phys.*, **20**, 1044–5 (June, 1952).

The fact that the heat capacity of the NaCl-structure phase of NH_4I , stable above 257°K, is 3.8 cal mole⁻¹ lower than that of the CsCl-structure low-temperature phase, as well as the small slope of the heat capacity curve of the former phase, and the difficulty in placing the NH_4 ion in an environment of 6 rather than 8 I ions, suggest that the NH_4 ion rotates. F. LACHMAN

539.132
6676. The dissociation energies of HS^+ and S_2^+ . H. L. FRIEDMAN. Letter in *J. Chem. Phys.*, **20**, 1046 (June, 1952).

If for $D(\text{S}_2)$ the value of 101 kcal is accepted instead of 76.6 kcal, the $D(\text{HS})$ calculated from the recent measurements of Franklin and Lumpkin becomes =79.2 kcal, thus agreeing with Porter's value of 84.9 kcal within the limits of experimental error. F. LACHMAN

539.132
6677. Analysis of the vibration states of the carbonyl groups of liquid cyclopentanone. F. TABOURY AND E. GRAY. *C.R. Acad. Sci. [Paris]* **234**, 2181–2 (May 26, 1952) *In French*.

Absorption and Raman spectra show differences in frequency, which are stated to be due to the coupling of two carbonyl groups. This explanation satisfies the selection rules enforced by the symmetry. A. J. TAYLOR

539.132
6678. The spatial correlation of electrons in molecules. J. E. LENNARD-JONES. *J. Chem. Phys.*, **20**, 1024–9 (June, 1952).

The wave functions of molecules in the ground states can be expressed to a good approximation as single determinants made up of terms orthogonal to each other. The probability distribution for such

systems can then also be expressed as a determinant. By integrating this quantity over all the spatial and spin co-ordinates except those of two electrons, a function is obtained which gives in effect the probability of finding a pair of electrons in assigned places with assigned spins. The properties of this function, called for short the correlation function, are examined in some particular cases. It is shown that the electrons of an inert gas atom, like Ne, tend to dispose themselves so that those of the same spin subtend tetrahedral angles at the nucleus. The six outer electrons of the N molecule and acetylene tend to the same approximation to arrange themselves so that those of the same spin are in three planes through the nuclear axis inclined at 120° to each other. Similarly the 8 outer electrons of the same spin in CO_2 tend to be correlated with each other in such a way that there are 4 between the C and the O nuclei and 4 at the extremities of the molecule, there being 2 on each O atom like "lone electrons." In general the "bonds" of a molecule, when interpreted in terms of molecular orbitals, may be regarded as providing the appropriate correlation of electrons of the same spin. A.

539.132
6679. Calculation of some electronic energy levels of sulfur hexafluoride. A. B. F. DUNCAN. *J. Chem. Phys.*, **20**, 951–60 (June, 1952).

An attempt has been made to calculate the coefficients in LCAO molecular orbital functions of SF_6 , and ionization and excitation energies of this molecule, using a self-consistent field method. The lowest ionization potential computed is 20.1 eV. Excitation energies to some forbidden and allowed levels are obtained, but are too large to be considered trustworthy. The present treatment was restricted in detail to 12 electrons, 6 from the sp^3d^2 valence configuration of S, and 6 $2p\sigma$ of F. The other electrons were treated in smoothed-out core potentials of the S and F atoms. It is believed that unexpectedly large errors may have been introduced by the neglect of detailed interactions of these electrons, and that the molecular orbitals in which they might be put are of importance. The present calculation is purely theoretical and only the empirical value of the S–F bond distance has been used. All necessary integrals have been evaluated, most of them for the first time, and are collected in tables. A.

539.132
6680. Extension of the concept of bond order. A. LAFORGUE AND C. VROELANT. *C.R. Acad. Sci. [Paris]* **234**, 2198–200 (May 26, 1952) *In French*.

Following the definition of charge [Abstr. 2867 (1952)] a new bond order is defined. This is derived from one-electron energies of the molecule but takes polarity of bonds into account. Interaction of configurations is also introduced. J. JACOBS

539.132
6681. Resonance in the hydrogen molecule. L. PAULING. Letter in *J. Chem. Phys.*, **20**, 1041 (June, 1952).

Shows that the Mueller–Eyring treatment by semi-localized orbitals is formally similar to Weinbaum's (1933) method. Comparable values are obtained for analogous parameters. H. H. GREENWOOD

- 539.132
6682. Transition probabilities. III. Dipole velocity computations for C_2 and N_2^+ . The question of degree of hybridization. H. SHULL. *J. Chem. Phys.*, **20**, 995-102 (July, 1952).
 For Pt II, see Abstr. 2876 (1952). Previous computations of transition probabilities for hydrogen using the dipole velocity operator are here extended to the diatomic molecules C_2 and N_2^+ with particular reference to the former. Whereas previous calculations have shown the dipole length method to be relatively insensitive to the effective nuclear charge, the present computations show great sensitivity of the dipole velocity method to the ratio of the effective Z of the bonding orbital to that of the antibonding orbital. The results are less sensitive to the absolute magnitude of the Z 's. The results are discussed with respect to reasonable assignments for the degree of s and $p\sigma$ -hybridization of the respective orbitals and with respect to reasonable choices for the effective Z values. It is concluded that the degree of hybridization is most probably considerably higher than previously estimated. The dipole velocity method is a promising one for further development. A.
- 539.133
6683. The ortho-para conversion of deuterium in molecular electric fields. Y. L. SANDLER. Letter in *J. Chem. Phys.*, **20**, 1050 (June, 1952).
 New measurements used high ortho-concentrations, including D_2O , SO_2 with small nuclear magnetism. The newly determined ratio of the rate constants is satisfactory. J. JACOBS
- 539.133
6684. Structure of the methyl halides. S. L. MILLER, L. C. AAMODT, G. DOUSMANIS, C. H. TOWNES AND J. KRAITCHMAN. *J. Chem. Phys.*, **20**, 1112-13 (July, 1952).
 Microwave spectroscopic measurements on the partially deuterated forms of CH_3Cl , CH_3Br and CH_3I allow a determination of the structural parameters which is less subject to zero-point vibration errors than other methods. In addition, examination of all measured isotopic species reveals that the C-D distance is shorter than C-H by 0.009 Å, and the D-C-D angle greater than that for H-C-H by about 12 minutes. Best values of structural parameters for the species containing the light isotope of hydrogen only are C-Cl distance 1.781, C-Br 1.939, C-I 2.139, C-H 1.11 (same for all halides), H-C-H angle $110^\circ 31'$ for CH_3Cl , $111^\circ 14'$ for CH_3Br , and $111^\circ 25'$ for CH_3I . Deuteration not only gives a change in the C-H bond but also a well-correlated change in the quadrupole constant of the halogen. A.
- 539.133 : 518.5
6685. Application of Eller's optical machine to the determination of the molecular structure of gases by electron diffraction. L. BRU, M. PÉREZ RODRIGUEZ AND M. CUBERO. *J. Chem. Phys.*, **20**, 1069-70 (July, 1952).
 See Abstr. 5002, 8352 (1951): An extraordinary reduction can be made in the time of calculations required in the trial and error method [Abstr. 5246 (1952)]. Application is made to the chloride monoxide molecule. A.
- 539.133
6686. Molecular size determination in macromolecular substances (criticism and comparison of methods). G. V. SCHULZ. *Experientia*, **8**, 171-82 (No. 5, 1952) In German.
 A survey is given of the most important methods for determination of molecular weight (osmotic pressure, ultracentrifuge and diffusion, light scattering, viscosity). All the methods require an extrapolation to zero concentration in order to use equations valid for ideal solutions. Furthermore, the polymolecularity of the examined substance must be considered, since each method yields a characteristic average of molecular weight differing from the others. The present limits of the methods are given and their results compared. A.
- 539.133
6687. Nuclear resonance measurements of the effect of stretching on the relaxation time T_2 of rubber. A. COHEN-HADRIA AND R. GABILLARD. *C.R. Acad. Sci. [Paris]* **234**, 1877-9 (May 5, 1952) In French.
 An experimental study of the variation of T_2 with temperature t has shown that, in the region $-15 < t < +5^\circ C$, dT_2/dt decreases proportionally to the increase in length. It is suggested that stretching alters the relative importance of the intramolecular and inter-chain spin-spin interactions. L. PINCHERLE
- 539.133
6688. Statistical theory of networks of non-Gaussian flexible chains. M. C. WANG AND E. GUTH. *J. Chem. Phys.*, **20**, 1144-57 (July, 1952).
 Aims to develop a self-consistent theory of rubber-like materials consisting of networks of non-Gaussian chain molecules. Three kinds of series developments are derived for the distribution function of perfectly flexible single chains from the Fourier integral solution of Rayleigh; namely, (1) long chains with actual extension much less than the maximum extension, (2) long chains with actual extension comparable to the maximum extension, and (3) short chains. In the non-Gaussian network theory, the leading term of the series (2) is used as the starting point for the individual chains of the network. Calculations are made for the case where the free junctions are moving with no restriction, and for the case where the free junctions are assumed to be at their most probable positions. The final expressions of the elastic energy for the two cases are compared, and it is shown that the percentage difference of the two expressions is of the order $1/n$ (n being the average number of links per chain), which is negligible for sufficiently large n . Finally an expression of the elastic energy is obtained with the assumption that all junctions are fixed and is shown to be, in general, a function of three strain invariants. The interdependence of the coefficients of the invariants is shown. Comparison of theory and experiment is given. Because of the interdependence of the coefficients only part of the observed deviations from Gaussian theory can be explained by this molecular theory. The remaining discrepancies must be ascribed to Van der Waals forces. This should show up in the (not yet investigated) temperature dependence of these discrepancies. A.

ATOMIC STRUCTURE : NUCLEUS
ISOTOPES 539.15

539.152.1
6689. On the shell model of nuclei. T. SEKL. *Acta Phys. Austriaca*, 5, 330-5 (No. 3, 1952) In German.

It is shown that the principles given by the author in 1934 for the construction of nuclear shells for the lightest nuclei appear to be applicable also to heavy nuclei.

L. PINCHERLE

539.152.1
6690. On the statistical theory of atomic nuclei. P. GOMBÁS. *Ann. Phys. [Lpz.]* 10, 253-64 (No. 4-5, 1952) In German.

The np , nn and pp interaction energy densities are written down in first approximation of the statistical model using a Yukawa interaction potential. To these are added the kinetic energy including Weizsäcker's correction for density gradients and the electrostatic energy including exchange; the total energy is then calculated for a Gaussian density distribution and compared with empirical masses.

W. J. SWIATECKI

539.152.1
6691. On the hydrodynamics of multipole oscillations of the atomic nucleus. M. DANOS. *Ann. Phys. [Lpz.]* 10, 265-81 (No. 4-5, 1952) In German.

The calculations of Jensen and Steinwedel (1950) are extended to include the correction to the resonance frequencies due to the electrostatic repulsion between the protons ($\Delta\omega/\omega = 1 \cdot 16 \times 10^{-4} A^{1/3}$) and the correction to the cross-sections due to retardation effects. The general Euler equations for a two-fluid flow are derived from the Lagrangian of the system.

W. J. SWIATECKI

539.152.1
6692. ^{83}Kr —the possible existence of a nuclear level preceding the metastable state. J. WALKER. Letter in *Proc. Phys. Soc. [Lond.] A*, 65, 449-50 (June, 1952).

A $\frac{3}{2}(-)$ level at 87 keV ($t < 10^{-2}$ sec) is inferred from cloud chamber photographs taken during studies of conversion electrons in isotopes of Br showing a fast and slow electron with a common origin.

W. J. SWIATECKI

539.152.1
6693. ^{83}Kr —an investigation of the radiations succeeding the metastable state. P. T. BARRETT. Letter in *Proc. Phys. Soc. [Lond.] A*, 65, 450-2 (June, 1952).

A proportional counter examination of these leads to a level scheme: $\frac{9}{2}(+)$ (ground state), $\frac{7}{2}(+)$ (9.3 keV, $t < 10^{-7}$ sec), $\frac{1}{2}(-)$ (32 keV).

W. J. SWIATECKI

539.152.1
6694. The parities of the ground states of N^{14} and C^{14} . D. A. BROMLEY AND L. M. GOLDMAN. Letter in *Phys. Rev.*, 86, 790 (June 1, 1952).

The angular distributions of the reactions $\text{C}^{13}(d, n)$ and $\text{C}^{13}(d, p)\text{C}^{14}$ were measured for 4 MeV, deuterons, and found to be similar with minima at 0° and maxima at 28° in the c-o-f-m system. These distributions agree well with those calculated from the Butler theory [Abstr. 8973 (1951)] for a transition in which the absorbed nucleon transfers one unit of angular momentum to the target nucleus. This shows the

parities of the ground states of N^{14} and C^{14} to be the same.

J. HUGHES

539.152.1
6695. Hyperfine structure of $p_{3/2}$ states. W. W. CLENDENIN. Letter in *Phys. Rev.*, 86, 810 (June 1, 1952).

A relativistic calculation of the correction to the apparent value of the nuclear moment factor g_I in the $p_{1/2}$ state due to the perturbation by the $p_{3/2}$ state. Results are in fair agreement with experimental data for Ga and In.

L. PINCHERLE

539.152.1
6696. Hyperfine structure anomalies in the $^2\text{P}_{1/2}$ state of Ti^{205} and Ti^{203} . A. BERMAN. *Phys. Rev.*, 86, 1005-8 (June 15, 1952).

The atomic beam magnetic resonance method was used to make a precision measurement of the hyperfine structure separation of the ground state of Ti^{205} and Ti^{203} . The experimentally determined ratio $\Delta\nu^{205}/\Delta\nu^{203} = 1.00974 \pm 0.00003$ is to be compared with the ratio of the magnetic moments, determined by nuclear induction techniques, of $g_I^{205}/g_I^{203} = 1.00986 \pm 0.00005$. It is shown that the difference between the two ratios can be accounted for by consideration of effects predicted by Bohr and Weisskopf and by Crawford and Schawlow. In particular, the agreement between theory and experiment can be construed as evidence of the reality of the effects postulated by Crawford and Schawlow, which have not been heretofore directly observed.

539.152.1 : 539.165.2

6697. β -Disintegrations and nuclear structure. II. Theoretical considerations: transition probabilities. R. NATAF AND R. BOUCHEZ. *J. Phys. Radium*, 133, 190-9 (April, 1952) In French.

For Pt I, see Abstr. 5981 (1952). The transition probability between two (LS) configurations is calculated on the basis of the hypotheses put forward in Pt I. The total transition probability between two given states may be deduced if one knows the amplitudes of the (LS) configurations occurring for these states. When there are many configurations with amplitudes of the same order, practically only one partial transition is of importance, and the formulae reduce to the usual expressions.

L. PINCHERLE

539.152.2
6698. A remark on Nordheim's rule concerning the angular momentum of odd-odd nuclei. R. NATAF. *C.R. Acad. Sci. [Paris]* 234, 1972-4 (May 12, 1952) In French.

The rule is deduced from the $j-j$ coupling between the odd proton and odd neutron and the fact that the ground state of the nucleus contains a maximum of the triplet component for those two nucleons.

W. J. SWIATECKI

539.152.2
6699. Quadrupole coupling ratio of the chlorine isotopes. T. C. WANG, C. H. TOWNES, A. L. SCHAWLOW AND A. N. HOLDEN. Letter in *Phys. Rev.* 86, 809 (June 1, 1952).

A series of measurements of radiofrequency transitions in $p\text{C}_6\text{H}_4\text{Cl}_2$, SbCl_3 , NaClO_3 , KClO_3 , CH_2Cl_2 has shown that the ratio of the nuclear quadrupole

coupling constants for Cl^{35} and Cl^{37} depends to about 0.02% on the molecular environment. L. PINCHERLE

539.152.2 : 539.153

6700. Angular momentum distributions in the Thomas-Fermi model. J. H. D. JENSEN AND J. M. LUTTINGER. *Phys. Rev.*, **86**, 907-11 (June 15, 1952).

The Hartree and Thomas-Fermi models of the atom and nucleus are compared in their predictions for the angular momentum distributions. It is found that the most natural quantity to compare is not the "first appearance" of a given orbital angular momentum, but the mean squared angular momentum. A.

539.153

6701. Poincaré's theorem and its uses. R. P. SINGH. *Indian J. Phys.*, **25**, 585-93 (Dec., 1951).

The paper contains a general statement of the Virial Theorem which has been applied to find the periods of fundamental mode of oscillation of the electronic cloud of an atom and also of an atomic nucleus. The method adopted is the same as used by Ledoux (1945) and Pekeris (1941) for calculating the period of oscillation of a variable star. The method seems to give values of correct order for the above quantities. A.

539.153

6702. The spatial correlation of electrons in atoms and molecules. I. Helium and similar two electron systems in their ground states. J. LENNARD-JONES AND J. A. POPLÉ. *Phil. Mag.*, **43**, 581-91 (May, 1952).

An attempt is made to improve the theory of two electrons of opposite spin in a field of spherical symmetry such as exists in some atoms. The method follows closely the theory of paired electrons in a chemical bond, given recently by the authors. In order to take fully into account the spatial correlation of the electrons due to their electrostatic repulsion, the wave function is expressed as a series. Each member of the series contains a function of the radial distances of the electrons multiplied by a Legendre function of the angle which the electrons subtend at the nucleus. It is then found possible to obtain a series of coupled equations for the radial functions in which the angular co-ordinate does not appear. The exact theory is used to examine some approximate expressions which have been used for the wave functions of the helium atom. Spatial correlation may occur in two ways. It may be of the "in-out" type, one electron tending to be outside the other, or it may be of the angular type, the two electrons tending to be on opposite sides of the nucleus. The spatial correlation of the electrons in helium in its ground state is examined from this point of view. A.

539.153

6703. Second-order radiative corrections to hyperfine structure. N. M. KROLL AND F. POLLOCK. *Phys. Rev.*, **86**, 876-88 (June 15, 1952).

The effect of 2nd-order radiative displacements of the energy levels of a bound electron on hyperfine structure separation is examined, and a correction to the Fermi formula for s levels is obtained. The treatment is based on an approximate evaluation of a finite, completely renormalized, and exact expression for the

2nd-order energy. The correction, which is restricted to atoms of small αZ , is found to be $[\alpha/2\pi - \alpha^2 Z(5/2 - \ln 2)]E_H$, where E_H is the Fermi energy. The effect of this and other corrections to the Fermi formula on the presently accepted value of the fine structure constant is discussed. A.

539.153

6704. Fine structure of the hydrogen atom. IV. W. E. LAMB, JR. AND R. C. RETHERFORD. *Phys. Rev.*, **86**, 1014-22 (June 15, 1952).

For Pt III, see Abstr. 2923 (1952). Contains an analysis of measurements made in 1950 on the fine structure of H and D. After application of numerous experimental and theoretical corrections the following results are obtained. The displacement $2^2S_{1/2} - 2^2P_{1/2}$ is 1058.27 Mc/s for H and 1059.71 Mc/s for D, each with a limit of error ± 1.0 Mc/s. There seems to be satisfactory agreement between these and the most recently calculated values. The difference of 1.44 Mc/s between D and H is compatible with an explanation based on reduced mass effects and the finite extension of the deuteron. The $2^2P_{3/2} - 2^2P_{1/2}$ separation for D is 10 972.11 Mc/s (limit of error ± 1.0 Mc/s). With assumption of a well-justified theoretical formula for the doublet splitting, one may calculate a value for the fine structure constant α . The result for $1/\alpha = 137.033$ (limit of error ± 0.006) is in distinct disagreement with the value $1/\alpha = 137.0429 \pm 0.0009$ derived from the hyperfine splitting of the ground state of H. The formula used for this was in error due to neglect of corrections of relative order $Z\alpha^2$, and is still in doubt because of reduced mass effects and spatial extent of nuclear magnetism. A.

539.153

6705. A numerical comparison of the density matrix of Rb^+ in the statistical approximation and in the Hartree approximation. P. O. FRÖMAN. *Ark. Fys.*, **5**, 135-9 (Paper 9, 1952).

The matrix $\langle r_0 | \rho | r \rangle$ is plotted as a function of $|r - r_0|$ for $r_0 = 1$ and 2 atomic units and the angle between r and r_0 equal to 0, $\pi/2$ and π . The two approximations differ considerably. W. J. SWIATECKI

539.153 : 538.114

6706. Nuclear resonance and the electronic structure of transition metals. W. D. KNIGHT AND C. KITTEL. Letter in *Phys. Rev.*, **86**, 573 (May 15, 1952).

Zener [Abstr. 4616 (1951)] has suggested that the body-centred structure of the transition metals V, Cr, Nb, Mo, Ta and W may be attributed to antiferromagnetic coupling between the $3d$ -shells on adjacent atoms. It is pointed out that the experimental evidence is rather against the possibility that all of these metals have "ordinary" antiferromagnetism. L. PINCHERLE

539.155.2

6707. Variations in the relative abundance of the carbon isotopes in plants. F. E. WICKMAN. Letter in *Nature [Lond.]* **169**, 1051 (June 21, 1952).

Reports values of the ratio of C_{12} to C_{13} for 100 plants. Values range from 89.0 to 90.4 for non-stagnant plants and around 91 for stagnant water and tropical rain-forest plants. This is explained in terms of the local carbon dioxide cycle. J. M. HOUGH

RADIOACTIVITY. α -, β - AND γ -RAYS 539.16

539.16.08

6708. The absolute determination of beta activities and the application to the determination of neutron densities. R. COHEN. *Ann. Phys. [Paris]* **7**, 185–237 (March–April, 1952) *In French*.

The methods available for the absolute determination of β -activities are briefly discussed, and the performance required from associated electronic equipment considered. A thorough account of the 4π counter is given, and the results of a comparison of this method, and the coincidence method, for the determination of the absolute strengths of Na^{24} and Mn^{56} sources. The application of these methods to the determination of neutron densities by activation methods is briefly discussed. Thirty-three references are given.

J. HUGHES

539.16.08 : 550.93

6709. Extension of the carbon 14 age method. J. L. KULP AND L. E. TRYON. *Rev. Sci. Instrum.*, **23**, 296–7 (June, 1952).

The use of a 1 in mercury shield around the screen wall counter inside the anticoincidence ring of cosmic-ray counters makes it possible to reduce the background from 5 to 2 counts/min for an active counting volume 8 in. in length and $2\frac{1}{2}$ in dia. This makes it possible to extend routine C^{14} age measurements from about 25 000 to 30 000 years.

A.

539.16.08 : 778.3

6710. On the measurement of the radioactivity of rocks with a photographic emulsion. R. COPPENS. *Bull. Soc. Franç. Minér. Crist.*, **75**, 57–8 (Jan.–March, 1952) *In French*.

Two corrections to a previous paper [Abstr. 4632 (1951)]. Firstly, the number of α -particles emitted per gram per sec by thorium is 4000 and not 3000; and secondly, the improved photographic emulsions permit the use of tracks equal to 2 and not 3 microns. It is not possible to correct the results given in the previous paper but they are of the right order of magnitude.

J. M. HOUGH

539.163

6711. Gold radioactivity in neutron irradiated diamond. M. S. FREEDMAN. Letter in *J. Chem. Phys.*, **20**, 1040 (June, 1952).

After pile irradiation, a 0.1 g light yellow gem diamond (never mounted) showed activity attributed to Au^{198} , from 1 or 2 micrograms of gold.

F. R. HOLT

539.163.1

6712. The half-life of tantalum-182. G. G. EICHHOLZ AND L. A. FICKO. Letter in *Phys. Rev.*, **86**, 794–5 (June 1, 1952).

The γ -radiation of Ta^{182} was monitored over $3\frac{1}{2}$ $\frac{1}{2}$ -lives, using an argon-filled pressure ionization-chamber and vibrating-reed electrometer. The $\frac{1}{2}$ -life obtained was 111.2 ± 0.5 days.

A. O. STANESBY

539.163.2

6713. Recent studies in the isotopes of emanation, francium and radium. F. F. MOMYER, E. K. HYDE, A. GHIORSO AND W. E. GLENN. Letter in *Phys. Rev.*, **86**, 805 (June 1, 1952).

The isotopes were obtained by 340-MeV protons on

Th and their α -decay characteristics were studied. Results on $\text{Em}^{209,10,11,12}$ reveal the shell at $N = 126$. Mass assignments in the system Fr^{212} – Em^{212} – At^{208} – Po^{208} were made certain by mass spectrography of Fr^{212} .

W. J. SWIATECKI

539.163.2

6714. Half-life and mass assignment of argon 39. H. ZELDES, B. H. KETELLE, A. R. CROSI, C. R. FULTZ AND R. F. HIBBS. Letter in *Phys. Rev.*, **86**, 811 (June 1, 1952).

Disintegration rates of four argon samples, purified from pile-irradiated KCl, were compared, and the volumes and isotopic abundances of three were determined. A magnetic lens β -spectrometer was used to determine the absolute disintegration rate of the fourth sample. It is concluded that Ar^{39} has a half-life of 265 ± 30 years.

T. G. PICKAVANCE

539.163.2

6715. Radiations from Nb^{97} . C. E. MANDEVILLE, E. SHAPIRO, R. I. MENDENHALL, E. R. ZUCKER AND G. L. CONKLIN. Letter in *Phys. Rev.*, **86**, 813 (June 1, 1952).

Zr^{96}O_2 was irradiated with slow neutrons and the Nb produced was separated chemically. The Zr^{97} half-life was 17.0 ± 0.2 hours, that of Nb^{97} 72.1 ± 0.7 minutes. The maximum Nb^{97} β -energy was 1.40 MeV and the spectrum was probably simple.

F. R. HOLT

539.163.2

6716. Radioactivities of platinum and iridium from photonuclear reactions in platinum. D. CHRISTIAN, R. F. MITCHELL AND D. S. MARTIN, JR. *Phys. Rev.*, **86**, 946–50 (June 15, 1952).

The products of photonuclear reactions induced in platinum by a 70-MeV synchrotron X-ray beam have been studied. No osmium activities were found. The iridium fraction included Ir^{192} and Ir^{194} and two new isotopes: a 140-min, 1-MeV β -emitter, probably Ir^{195} , and a 7-min activity, probably Ir^{197} . Pt^{193} , Pt^{197} and the 88-min isotope which decays by isomeric transition were found in the platinum fraction. Some evidence is presented to question the assignment of the 88-min activity to Pt^{195} . Relative yields of all these radioactive isotopes have been measured.

A.

539.163.2

6717. Decay of Sr^{85} and Sr^{85m} . A. W. SUNYAR, J. W. MIHELICH, G. SCHARFF-GOLDHABER, M. GOLDHABER, N. S. WALL AND M. DEUTSCH. *Phys. Rev.*, **86**, 1023–7 (June 15, 1952).

Sr^{85} (65 day) decays by K -capture to an excited state of Rb^{85} of 513-keV energy. This state is found to have a half-life of $(0.9 \pm 0.2) \mu\text{sec}$. It decays to the ground state of Rb^{85} by an $M2$ transition, identified by its internal conversion coefficient. Sr^{85m} (70 min) decays in three ways: 14% by K -capture to an excited state of Rb^{85} of 150 keV, 84.7% by an $E3$ transition of 7.5 ± 1 keV followed by an $M1$ transition of 225 keV, and 1.3% by an $M4$ crossover transition of 232.5 keV. A decay scheme for Sr^{85} , Rb^{85m} and Sr^{85m} consistent with shell theory and isomer systematics is given. The existence of large ft values for allowed β -transitions near closed shells is interpreted as due to a rearrangement of nucleons in the even-even core of an odd A nucleus.

A.

6718. The decay of ^{188}Re . R. RICHMOND, P. J. GRANT AND H. ROSE. *Proc. Phys. Soc. [London]* **A**, **5**, 484-90 (July, 1952).
The γ -rays emitted in the decay of Re^{188} have been investigated by means of absorption and coincidence techniques and by the use of a thin-lens β -ray spectrometer. The γ -ray intensities (expressed as a percentage of the total number of β -disintegrations) have been measured and a probable decay scheme is proposed. A.
- 539.163.2 : 539.164
5719. A new measurement of the fine structure intensities of the transition $\text{AcC} - \frac{\alpha}{\gamma} \rightarrow \text{AcC}''$. G. VIEIRA AND L. SALGUEIRO. *C.R. Acad. Sci. [Paris]* **234**, 1765-7 (April 28, 1952) *In French*.
The energies and intensity ratio of the 2 α -groups were found with a permanent magnet α -spectrograph using nuclear emulsions; the corrected intensity ratio $\alpha_1/\alpha_0 = 0.211$, the energies $E\alpha_0 = 6.621$, $E\alpha_1 = 6.274$ MeV (370 670 and 360 815 oersted cm) and the disintegration energy difference = 353 keV. A. O. STANESBY
- 539.163.2 : 539.166
5720. The radioactive decay of ruthenium 103. J. M. CORK, J. M. LEBLANC, F. B. STUMPF AND W. H. NESTER. Letter in *Phys. Rev.*, **86**, 575-6 (May 15, 1952).
A study of Ru^{103} showed several new γ -rays. A proposed level scheme is given. A. O. STANESBY
- 539.163.2 : 539.166
5721. Gamma-radiations from 36.5-hr Rh^{105g} . G. E. BOYD. Letter in *Phys. Rev.*, **86**, 578 (May 15, 1952).
Using a NaI(Tl) scintillation spectrometer, γ -ray lines were found at 322, 157 (very weak) and possibly 80 (± 5) keV; β - γ -coincidence measurements showed the β -spectrum to be complex, with component end-points at 250 and 570 keV. Spin assignments for the two levels are discussed. A. O. STANESBY
- 539.163.2 : 539.166
6722. The spectrum of L X-rays from RaD and the possibility of $L_I \rightarrow L_{II}$ Auger transitions. S. G. COHEN AND A. A. JAFFE. Letter in *Phys. Rev.*, **86**, 800-1 (June 1, 1952).
The spectrum of L X-rays emitted during the disintegration of RaD was examined using a proportional counter, and a new line observed at 15.3 ± 0.3 keV. Discussion of the relative intensities of the lines indicates that Coster-Kronig transitions $L_I \rightarrow L_{II}N$ do not occur in more than 5% of the L_I shell vacancies. A. O. STANESBY
- 539.164.75
6723. Experimental determination of the α -ray absorption coefficient of a substance of unknown chemical composition, and investigation of the uranium and thorium contents of a radioactive substance by autoradiography. R. COPPENS AND G. VERNOS. *C.R. Acad. Sci. [Paris]* **234**, 1974-6 (May 12, 1952) *In French*.
Alpha-ray counts are made on a radioactive substance (A) of unknown composition and on a mixture of A with an inactive substance of known composition.
- The absorption coefficient and uranium or thorium content of A may then be evaluated explicitly. J. J. WILKINS
- 539.164.75
6724. Stopping power of polystyrene and acetylene for alpha-particles. R. H. ELLIS, JR., H. H. ROSSI AND G. FAILLA. Letter in *Phys. Rev.*, **86**, 562-3 (May 15, 1952).
These were compared by measuring the change in ionization in a windowless ionization chamber when a thin film of polystyrene is interposed inside an enclosure containing acetylene. It is concluded that the relative stopping powers of gas and solid are independent of the α -particle energy. W. J. SWIATECKI
- 539.165
6725. The auto-absorption of β -radiation from P^{32} . C. HAENNY AND P. LERCH. *Helv. Phys. Acta*, **24**, 602-6 (No. 6, 1951) *In French*.
Using a fixed experimental arrangement (with Geiger counter as detector) and a range of substances containing P^{32} , measurements were made of activity v , source thickness. Absorption curves were drawn from these measurements, and from the exponents of the curves "auto-absorption" coefficients were deduced which allow the strengths of the sources to be corrected for the absorption in the material itself. When expressed as an absorption coefficient per electron, the variation for substances with a mean atomic number ranging from 5 to 25 is very small, and the coefficient is approximately $3.6 \times 10^{-24} \text{ cm}^2$ electron. L. E. MUSSELL
- 539.165
6726. The emission of light positive particles by β -emitters. P. M. WEINZIERL. *Acta Phys. Austriaca*, **5**, 265-85 (No. 3, 1952) *In German*.
Reported cloud chamber observations of positive tracks (not positrons) accompanying β -decay and of the emission of a positive and negative spectrum of very light particles associated with β -activity are collected and possible interpretations are discussed. No final conclusion is possible on whether this is due to a new kind of radiation or to spurious experimental effects, but the balance of the evidence favours the former alternative. W. J. SWIATECKI
- 539.165
6727. The decay energy of Si^{31} . A. H. WAPSTRA. Letter in *Phys. Rev.*, **86**, 561-2 (May 15, 1952).
A re-determination of the β -spectrum of Si^{31} gives a mass difference $\text{P}^{31} - \text{Si}^{28} = 26.380 \pm 0.020$ MeV in agreement with deductions from nuclear reaction Q -values and casting doubt on Ewald's mass-spectrographic results [Abstr. 8149 (1951)]. W. J. SWIATECKI
- 539.165
6728. The decay energy of Pb^{209} . A. H. WAPSTRA. Letter in *Phys. Rev.*, **86**, 562 (May 15, 1952).
In a study of the decay of Pb^{209} no evidence was found for an isomeric state Bi^{209m} . An absorption curve of Pb^{209} and a β -spectrometer study gave 0.64 ± 0.03 and 0.635 ± 0.10 MeV for the decay energy. The absence of conversion lines or γ or K radiations all point to the decay being a ground-state transition. W. J. SWIATECKI

539.165
6729. Energy available for double beta-decay of Sn^{124} . B. G. HOGG AND H. E. DUCKWORTH. Letter in *Phys. Rev.*, **86**, 567 (May 15, 1952).

The mass difference $\text{Sn}^{124}\text{-Te}^{124}$ was measured in a mass-spectrograph as 0.00162 ± 0.00044 atomic mass units, or 1.4 ± 0.4 MeV, giving a lower limit [see Abstr. 2937 (1952)] for the Sn^{124} double β -decay of $2.1 \pm 0.3 \times 10^{17}$ yr [see also Fireman's result, Abstr. 2672 (1949)].
A. O. STANESBY

539.165
6730. Calorimetric determination of the relationship between the half-life and average beta-energy of C^{14} . G. H. JENKS AND F. H. SWEETON. Letter in *Phys. Rev.*, **86**, 803 (June 1, 1952).

This was done using a liquid He calorimeter. The deduced average β -energy (45 keV) agrees with measurements of the β -spectrum.
W. J. SWIATECKI

539.165 : 539.18
6731. μ -Meson decay and β -radioactivity. L. MICHEL. Letter in *Phys. Rev.*, **86**, 814 (June 1, 1952).

The possibility of accounting for β -radioactivity, μ -meson decay and μ -capture by heavy nuclei using "the same" direct interaction between the 3 sets of 4 fermions is discussed in relation to the interpretation of the μ -decay electron spectrum.
W. J. SWIATECKI

539.165.2
6732. On the charge of the recoil atom in the β -decay of He^6 . A. WINTHER. *K. Danske Vidensk. Selsk. Mat.-fys. Medd.*, **27**, 16 pp. (No. 2, 1952).

This has been calculated, the average charge on the lithium recoil is 1.105 ± 0.015 , the ionization probability being $(10.5 \pm 1.5)\%$.
J. HUGHES

539.165.2
6733. The third forbidden beta-spectrum from Rb^{87} . Y. TOMOZAWA, M. UMEZAWA AND S. NAKAMURA. Letter in *Phys. Rev.*, **86**, 791 (June 1, 1952).

The Fermi plot corrected by the 3rd forbidden correction function (spin change 3 and parity change, as suggested by the $(p_{3/2})^{-1}$ and $(g_{3/2})^{-1}$ configurations of Rb^{87} and Sr^{87}) gave a straight line. The ft value is 4.2×10^{16} , $t = 6 \times 10^{10}$ years.
W. J. SWIATECKI

539.165.2
6734. Nuclear matrix elements in the theory of beta-decay. H. BRYSK. *Phys. Rev.*, **86**, 996–1004 (June 15, 1952).

An approach was developed whereby the nuclear matrix elements could be calculated for the odd- A and half of the even- A β -radioactive nuclei. The designation of nuclear states is made in accordance with the Mayer shell model and its extension by Nordheim to the even- A nuclei. The transforming nucleon is assigned the wave functions of a Dirac particle in a "square-well" potential representing the nuclear "core." Expressions for the matrix elements were determined and compared with the data. Consistent agreement is found for the tensor interaction.
A.

539.165.8
6735. Nuclear recoil following neutrino emission from beryllium 7. R. DAVIS, JR. *Phys. Rev.*, **86**, 976–84 (June 15, 1952).

The nuclear recoil spectrum of the electron capture isotope Be^7 was measured from nearly monolayer

deposits of the isotope on lithium fluoride and tungsten surfaces. The recoil spectrum was measured with an electrostatic analyser having a 2% resolution. The spectra exhibited a peak at the high-energy end of the spectrum consistent with the hypothesis of single neutrino emission in Be^7 . The maximum recoil ion energy observed was 55.9 ± 1.0 eV.
A.

539.166
6736. Soft radiations from Am^{241} . J. K. BELING, J. O. NEWTON AND B. ROSE. Letter in *Phys. Rev.*, **86**, 797–8 (June 1, 1952).

The γ - and X-radiation emitted by Am^{241} were examined using a proportional counter filled with Ar, Kr or Xe. Lines were found at 13.5 ± 0.2 , 17.3 ± 0.2 , 20.9 ± 0.2 (probably L_{α} , L_{β} and L_{γ} X-rays resp. of Np^{237}), 26.3 ± 0.2 and 59.7 ± 0.3 keV, with relative intensities 0.42 ± 0.04 , 0.66 ± 0.04 , 0.177 ± 0.018 , 0.075 ± 0.008 , 1 resp. The abs. intensity of the 59.7 keV γ -ray was 0.40 ± 0.015 per α -particle emitted.
A. O. STANESBY

539.166
6737. A source of plane-polarized gamma-rays of variable energy above 5.5 MeV. D. H. WILKINSON. *Phil. Mag.*, **43**, 659–62 (June, 1952).

The reaction $\text{H}^2(p, \gamma)\text{He}^3$ should constitute a source of plane-polarized γ -rays; the reaction is one of direct radiative capture and spin-orbit coupling is not strong enough to induce changes in the z component of the intrinsic spins of the interacting particles. The γ -ray energy may be varied from 5.5 MeV upwards by changing the energy of the bombarding protons. The polarization has been demonstrated by using the γ -rays to disintegrate deuterons contained in a photographic plate; the photoprotons are emitted preferentially along the line of the electric vector.
A.

539.166
6738. The classification of multipole radiation. B. JEFFREYS. *Proc. Camb. Phil. Soc.*, **48**, 470–81 (Pt 3, 1952).

A detailed account is given of the classification of the electromagnetic fields arising from a vibrating charge-current distribution. The work owes much to that of Berestetzky and Fierz, but differs from their treatments in that the exact expansions are taken as a starting point. Hence the general forms of the potentials and fields and their approximate forms are obtained directly. Formulae appropriate to large distances are given. The relation to the approach of Condon and Shortley (1935) is discussed.
A.

539.166.75
6739. Gamma-ray absorption coefficients. C. M. DAVISSON AND R. D. EVANS. *Rev. Mod. Phys.*, **24**, 79–107 (April, 1952).

A survey is given of the absorption of radiation in the energy range from 0.1 MeV to 6 MeV. Results of the theories of Compton effect, photoelectric effect and pair production are given in the form of equations, tables and curves. Necessary considerations in studying absorption coefficients are discussed and results of various workers are compared with theory. It is concluded that in this energy range the present theories give values of absorption coefficients which are in good agreement with those obtained experimentally.
A.

539.166.83
6740. The β -spectrum of internal conversion emitted on the transmutation thorium $X \rightarrow$ thoron. S. ROSENBLUM, M. VALADARES AND M. GUILLLOT. *C.R. Acad. Sci. [Paris]* **234**, 1767–9 (April 28, 1952) In French.

By means of a 180° β -spectrograph new internal conversion lines were found of which 2 can be attributed to K and L_{III} conversions in $ThX \rightarrow Tn$. The intensity of one of them when compared with the theory of Rose *et al.* [Abstr. 7249 (1951)] suggests electric quadrupole radiation. W. J. SWIATECKI

539.166.83
6741. The determination of the internal conversion coefficient and branching ratio for the 80-keV γ -ray emitted by I^{131} by means of X-ray- γ -ray coincidence measurements. P. E. CAVANAGH. *Phil. Mag.*, **43**, 548–58 (June, 1952).

The investigation of primary and secondary electron spectra as a means of determining conversion coefficients becomes difficult at low γ -ray energies. A method relying on the measurement of the X-rays emitted as a result of internal conversion does not suffer from this disadvantage. Such a method has been applied to the 80-keV γ -ray emitted by I^{131} . This is believed to be in cascade with a 283-keV γ -ray, the two forming a branch parallel to the most intense γ -ray of 363 keV. X-rays arising from the conversion of the 80-keV γ -ray should be in coincidence with 283-keV γ -rays. Such coincidences were found, and the proportion of such X-rays in the total number measured. The relative number of these X-rays and unconverted 80-keV quanta gives 1.83 ± 0.16 as the internal conversion coefficient, which places the 80-keV transition as magnetic dipole. It occurs in $(4.3 \pm 0.6)\%$ of the total number of disintegrations. Evidence for X-rays in coincidence with 638-keV γ -rays was also found. It is possible that these arise from the conversion of a γ -ray emitted in a transition between levels at 638 and 720 keV, of occurrence 0.3% per disintegration. A.

539.166.83
6742. Internal conversion in I^{131} . D. ROSE, G. HINMAN AND L. G. LANG. *Phys. Rev.*, **86**, 863–4 (June 15, 1952).

The β -radiations from the decay of I^{131} to Xe^{131} have been investigated in a large ($\rho = 50$ cm) double-focusing β -ray spectrometer to determine the internal conversion coefficients for the 284, 364, 638 and 724-keV γ -rays. The continuous β -spectrum is resolved into 3 components with end points of 338, 606 and 807 keV. Conclusions about the multipole character of the γ -ray transitions are made. A.

539.166.832
6743. The polarization of electrons in Compton scattering. H. ROBL. *Acta Phys. Austriaca*, **5**, 319–29 (No. 3, 1952) In German.

The calculation is limited to the case where the initial electron spin is parallel to the direction of motion and where the light quantum is scattered through 90° . A change in the spin direction becomes probable only when $h\nu$ is not small compared to mc^2 . W. J. SWIATECKI

539.166.835
6744. Gamma to positron ratio of copper 64. H. T. VLAAR AND A. H. W. ATEN, JR. Letter in *Physica*, **18**, 275–6 (April, 1952).

Absorption measurements gave $\gamma/\beta^+ = 0.023 \pm 0.004$. J. J. WILKINS

539.166.835
6745. Relative pair production cross sections in the energy region 50 to 300 MeV. C. R. EMIGH. *Phys. Rev.*, **86**, 1028–34 (June 15, 1952).

A cloud-chamber survey has been made of pairs produced in Al, Ag, Au and Th foils by an X-ray beam from the 300-MeV betatron. By comparing the pairs produced in two of the foils mounted to intercept the same X-ray beam, values of the relative pair production cross-sections for Ag to Al, Au to Al, and Th to Al were found to be respectively (3.4 ± 1.4) , (7.9 ± 1.5) and $(11.7 \pm 1.7)\%$ low compared with the Bethe-Heitler theory predictions. The results are consistent with a correction factor to the theoretical pair cross-section given by $[1 - (1.4 \pm 0.1)10^{-3}Z^2]$. The calculated number of Compton electrons between 50 and 200 MeV expected from the Al foil is 1201, from the Ag foil is 355, and from the Au foil is 113. The observed numbers with statistical errors indicated are respectively 1170 ± 40 , 354 ± 30 and 70 ± 18 . A.

NUCLEAR REACTIONS 539.17

539.172
6746. A note on time reversal in polarized nuclear processes. R. J. BLIN-STOYLE. Letter in *Proc. Phys. Soc. [Lond.] A*, **65**, 452–3 (June, 1952).

A relation between the angular distributions of spin- $\frac{1}{2}$ particles with a given polarization arising in the processes $A + P \rightarrow B + Q$ and $B + Q \rightarrow A + P$ is deduced from the invariance of the Hamiltonian under reflection of axes and time reversal. W. J. SWIATECKI

539.172
6747. A combinatorial problem in electron-photon cascade theory. R. B. POTTS. Letter in *Proc. Phys. Soc. [Lond.] A*, **65**, 459–60 (June, 1952).

The number of different cascades in which a primary e or γ gives rise to given numbers of e 's and γ 's is given. W. J. SWIATECKI

539.172 : 537.591.8
Nuclear reactions due to cosmic rays. See Abstr. 6604–5, 6614

539.172 : 541.126
6748. Experimental efforts to find radioactivity induced by the firing of shaped charges. G. J. PLAIN, J. C. McLAUGHLIN AND F. K. ODENERANTZ. Letter in *J. Chem. Phys.*, **20**, 1049 (June, 1952).

Contrary to Fonberg's findings [Abstr. 5735 (1951)], no radioactivity could be detected either by radiation counters or by photographic plates after 9 shaped charges were fired into targets of brass, Al, Ag, Zn and Li. F. LACHMAN

539.172
6749. Capture of negative μ mesons in copper and tin. A. LAGARRIGUE AND C. PEYROU. *C.R. Acad. Sci. [Paris]* **234**, 1873-5 (May 5, 1952) In French.

An analysis of several hundred cloud chamber photographs of mesons stopped in Cu or Sb plates indicates that the processes $\mu^- + P$ or $N \rightarrow P$ or $N + e^-$ do not occur. W. J. SWIATECKI

539.172
6750. On the capture of μ -mesons by calcium. J. HEIDMANN. *C.R. Acad. Sci. [Paris]* **234**, 2062-3 (May 19, 1952) In French.

The average number of neutrons emitted following μ^- -capture according to $\mu^- + Ca^{40} \rightarrow K^{40*} + \nu$ is calculated to be 0.1-0.7, using results of Tiomno and Wheeler [Abstr. 3461-2 (1949)] for the probability of an excitation E of K^{40*} , and the compound nucleus for the probability of neutron emission at this excitation. W. J. SWIATECKI

539.172.13
6751. Angular distributions of inelastically scattered protons from C^{12} and Mg^{24} . H. E. GOVE AND H. F. STODDARD. Letter in *Phys. Rev.*, **86**, 572-3 (May 15, 1952).

These were measured, for 7.3 MeV incident protons, using a NaI crystal and photomultiplier as detector. Graphs are given of the angular distributions, both of which are asymmetrical about 90° in the c.-of-m. system. J. HUGHES

539.172.13
6752. Neutron groups from protons on Cr^{53} , Co^{59} and Cl^{37} . P. H. STELSON AND W. M. PRESTON. Letter in *Phys. Rev.*, **86**, 807 (June 1, 1952).

By measuring the neutron groups from (p, n) reactions revealed by recoil proton tracks in emulsions the energies of levels up to ~ 1.5 MeV were determined for A^{37} , Cr^{51} , Mn^{53} , Fe^{55} , Ni^{59} . W. J. SWIATECKI

539.172.13
6753. Nuclear energy levels of Al^{27} . E. M. REILLEY, A. J. ALLEN, J. S. ARTHUR, R. S. BENDER, R. L. ELY AND H. J. HAUSMAN. *Phys. Rev.*, **86**, 857-8 (June 15, 1952).

Twenty energy levels in Al^{27} have been found by the magnetic analysis of inelastically scattered protons at 90° from thin targets of Al. An analysed beam of 8.0-MeV protons was utilized for the bombardment. Tentative values for the levels found are 0.844, 1.016, 2.259, 2.782, 3.046, 3.736, 4.018, 4.115, 4.473, 4.575, 4.647, 4.875, 4.996, 5.107, 5.220, 5.341, 5.501, 5.565, 5.620, 5.736 MeV. A broad α -particle group from $Al^{27}(p, \alpha)Mg^{24}$ reaction corresponding to an excited state of Mg^{24} was also observed and is believed to be complex. A.

539.172.13
6754. Inelastic scattering of protons from nickel. R. ELY, JR., A. J. ALLEN, J. S. ARTHUR, R. S. BENDER, H. J. HAUSMAN AND E. M. REILLEY. *Phys. Rev.*, **86**, 859-60 (June 15, 1952).

By use of the equipment developed for the precision scattering project at the University of Pittsburgh, inelastic scattering of 8-MeV protons from a thin Ni target has been observed at 90° . The energy levels

obtained for natural Ni are 1.344, 1.479, 2.186, 2.326, 2.501, 2.660, 2.814, 2.946, 3.081, 3.161, 3.226, 3.308, 3.462, 3.575, 3.646, 3.773, 3.823, 3.944, 3.979, 4.066 MeV. At present, only the three levels 1.344, 1.479, 2.501 MeV can be assigned to Ni^{60} from comparison with β -decay of Co^{60} . A.

539.172.13 : 539.166
6755. Angular correlation between γ -rays and inelastically scattered protons from Mg^{24} . H. E. GOVE AND A. HEDGRAN. Letter in *Phys. Rev.*, **86**, 574-5 (May 15, 1952).

539.172.13
6756. Angular distribution in (d, p) and (d, n) reactions. A. B. BHATIA, K. HUANG, R. HUBY AND H. C. NEWNS. *Phil. Mag.*, **43**, 485-500 (May, 1952).

The angular distribution is calculated, assuming a stripping process, by means of the Born approximation. The result resembles in most respects that of more complicated calculations by Butler [Abstr. 8973 (1951)], but there are certain differences which are discussed in relation to experiments which have been, or may be done. The particles are emitted mainly at fairly small angles to the incident direction, and the precise shape of the distribution is simply related to changes of angular momentum and parity occurring. The principal unknowns in the formulae are matrix elements, which may be estimated for sufficiently high energies by the statistical method. A.

539.172.13
6757. Q values of the $C^{12}(d, p)C^{13}$, $Be^9(d, p)Be^{10}$, and $O^{16}(d, p)O^{17}$ reactions. E. D. KLEMA AND G. C. PHILLIPS. *Phys. Rev.*, **86**, 951-4 (June 15, 1952).

The Q values of the reactions listed above have been obtained by measuring the energies of the disintegration protons by means of an annular magnet whose magnetic field was measured and kept constant by a proton magnetic moment regulator. The energy of the incident deuterons was measured in terms of the 0.8735-MeV $F^{19}(p, \alpha\gamma)O^{16}$ resonance. The values obtained for the above reactions are 2.732 ± 0.006 MeV, 4.591 ± 0.008 MeV and 1.918 ± 0.008 MeV, respectively. The neutron-proton mass difference as calculated from the present data for carbon and the data given by other workers for the Q 's of a closed cycle of reactions involving C^{12} and C^{13} is 0.789 ± 0.008 MeV. A.

539.172.13
6758. Search for alpha-particles from the $O^{16}(d, \alpha)N^{14*}$ reaction. R. J. VAN DE GRAAFF, A. SPERDUTO, W. W. BUECHNER AND H. A. ENGEL. *Phys. Rev.*, **86**, 966-7 (June 15, 1952).

Studies of the γ -rays from several nuclear reactions have indicated the existence of an energy level in N^{14} at approximately 2.3 MeV. An investigation of the $O^{16}(d, \alpha)N^{14}$ reaction has been carried out in order to investigate this region of excitation in N^{14} . Two-million-volt deuterons from an electrostatic generator were employed, and the α -particles were analysed with a magnetic spectrograph. The region of excitation studied was from 0 to 2.8 MeV. With the exception of the ground-state group, no α -particle groups were found, although any group with an intensity greater than 2% of the ground-state group would have been observed. A.

- 539.172.4
59. Energy dependence of ($n, 2n$) reactions in Ni^{58} , Ni^{63} , and Ti^{63} from 11 to 19 MeV. H. C. MARTIN and B. C. DIVEN. Letter in *Phys. Rev.*, **86**, 565-7 (May 15, 1952).
 Determined by measuring the induced activities produced by neutrons from the $\text{D}(t, n)\text{He}^4$ reaction. The Cu and Ni activities were measured with G.M. counters, and that of the Ti by counting the pulses in the photo-peak produced by the 431 keV, Ti γ -ray with a NaI(Tl) scintillation detector. J. HUGHES
- 539.172.4
60. The capture of thermal neutrons by the thulium isotope 238. J. GUÉRON and E. BRODA. *Acta Phys. Austriaca*, **5**, 414-15 (No. 3, 1952) In German.
 The agreement between the value obtained by the authors in 1942 and recent measurements is discussed. W. J. SWIATECKI
- 539.172.4
61. Nuclear constants for reactor studies. *Atomies [Lond.]*, **3**, 156 (June, 1952).
 In addition to the figures previously given for various nuclear constants of U^{235} and U^{238} (which are now revised) data is released on the fission, capture cross-sections and ν of Pu^{239} for thermal neutrons, nuclear constants of natural uranium for fast neutrons (above the U^{238} fission threshold), thermal neutron absorption cross-section of Xe^{135} and temperature dependence of the resonance absorption integral in natural U. L. R. SHEPHERD
- TOM AND MOLECULE BEAMS . MESONS NEUTRONS** 539.18
- 539.18
62. Mesons. W. O. LOCK and H. MUIRHEAD. *Experientia*, **7**, 321-36 (Sept., 1951).
 A review article for non-specialists. 4 figs., 8 photographs, 98 refs.
- 539.18
63. An argument against the Majorana theory of neutral particles. E. R. CAIANIELLO. Letter in *Phys. Rev.*, **86**, 564-5 (May 15, 1952).
 This is in the form of a proof that the identity of a field with its charge conjugate is impossible because the two transform differently under space reversal. W. J. SWIATECKI
- 539.18
64. Pion production and charge independence. M. LUTTINGER. Letter in *Phys. Rev.*, **86**, 571-2 (May 15, 1952).
 Pion production in nucleon-deuteron collisions provides a severe test of the assumption of charge independence. This assumption implies that the interaction is such that the total isotopic spin is unchanged. It follows, for instance, that for $p + d$ or $n + d$ collisions $\sigma(\pi^+) + \sigma(\pi^-) = 2\sigma(\pi^0)$ and $\sigma(p + p \rightarrow p + n + \pi^+) = 2[\sigma(n + p \rightarrow n + p + \pi^0) + \sigma(p + p \rightarrow p + p + \pi^0) - \sigma(n + p \rightarrow n + n + \pi^+)]$ independently of the details of the interaction. W. J. SWIATECKI
- 539.18
65. Experimental study of the energy spectrum of the electron from the disintegration of the μ -meson. A. LAGARRIGUE. *C.R. Acad. Sci. [Paris]* **234**, 2060-1 (May 19, 1952) In French.
 An analysis of 225 energy measurements using a cloud chamber in a magnetic field shows complete agreement with L. Michel's calculated spectrum with a maximum energy $W = 55.3 \pm 2$ MeV and $\rho = 0.19 \pm 0.13$. W. J. SWIATECKI
- 539.18
66. The properties of charged V-particles. R. ARMENTEROS, K. H. BARKER, C. C. BUTLER, A. CACHON and C. M. YORK. *Phil. Mag.*, **43**, 597-612 (June, 1952).
 Twenty-one examples of the decay of charged V-particles have been found among 25 000 counter-controlled cloud-chamber photographs obtained on the Pic-du-Midi (2867 m). These events have been analysed and compared with the data obtained by other groups. The measurements show that, if the majority of the $V^\pm$ -tracks are produced by one type of particle having a single mode of decay, there must be at least two neutral secondary particles, in addition to the charged secondary particle. The latter is probably a μ - or a π -meson and the combined mass of the neutral particles must be less than $1000 m_e$. Since the κ -particles, of mass about $1200 m_e$, which were discovered in photographic emulsions, also decay into a charged meson and at least two neutral particles, it is plausible to assume, provisionally, that the $V^\pm$ -particles and the κ -particles are the same. On this assumption most of the available data concerning $V^\pm$ - and κ -particles can be explained if the unstable particle has a mass of about $1200 m_e$ and decays into a charged μ -meson, a π^0 -meson and a neutrino, or alternatively into a charged μ -meson and two neutrinos. As yet no direct evidence has been found for the existence of a π^0 -meson in the decay scheme. One negatively charged V-particle probably produced a neutral V-track and a charged meson. A.
- 539.18
67. Angular distribution of pions scattered by hydrogen. H. L. ANDERSON, E. FERMI, D. E. NAGLE and G. B. YODH. Letter in *Phys. Rev.*, **86**, 793 (June 1, 1952).
 Elastic scattering of π^+ at 110 and 135 MeV and both charge exchange and elastic scattering of π^- at 135 MeV were measured at 45° , 90° and 135° laboratory angle and a phase shift analysis made in terms of S_1 , $P_{\frac{1}{2}}$ and $P_{\frac{3}{2}}$ states with isotopic spin $\frac{1}{2}$ and $\frac{3}{2}$. W. J. SWIATECKI
- 539.18
68. Scattering and capture of pions by hydrogen. H. L. ANDERSON and E. FERMI. Letter in *Phys. Rev.*, **86**, 794 (June 1, 1952).
 The charge exchange scattering of π^- by the proton is closely related to the capture of a π^- from a Bohr-like orbit with the production of a neutron and a π^0 , which in turn is known to be about as probable as π^- capture with γ -emission. The cross-section for photomeson production can thus be correlated with charge exchange scattering and agreement is indeed found. W. J. SWIATECKI

539.18

6769. Charged photomesons from various nuclei. R. M. LITTAUER AND D. WALKER. *Phys. Rev.*, **86**, 838–46 (June 15, 1952).

The yield of π^- and π^+ photomesons from a wide range of nuclei has been measured. The irradiating photon flux was 310-MeV bremsstrahlung and the mesons were selected magnetically at 135° with an energy of 65 ± 15 MeV. The experimental results include the following features: (1) the π^-/π^+ ratio from deuterium is close to unity; (2) the charged meson cross-sections for deuterium are close to that for hydrogen; (3) the total charged meson cross-section per nucleus varies as $A^{1/3}$; (4) the π^-/π^+ ratios show a remarkable correlation with the masses of the isobars adjacent in Z to the target nucleus; (5) the π^-/π^+ ratio from beryllium is energy-sensitive. The implications of these results are discussed. A.

539.18

6770. Phenomenological relationships between photomeson production and meson-nucleon scattering. K. A. BRUECKNER AND K. M. WATSON. *Phys. Rev.*, **86**, 923–8 (June 15, 1952).

Photomeson production is studied on the basis of the hypothesis of charge independence combined with the suggestion from meson theory that the meson-nucleon state of angular momentum and isotopic angular momentum equal to $\frac{3}{2}$ is one of strong, resonant interaction. Reasonable agreement with experiment is obtained, both as to the energy dependence of the cross-sections and as to their ratios. Similar considerations lead to a possible explanation for the angular dependence of π^+ mesons produced in p - p collisions. A.

539.18 : 537.591.1

6771. The varitrons. A. I. ALIKHANYAN AND A. I. ALIKHANOV. *Zh. Eksper. Teor. Fiz.*, **21**, 1023–44 (No. 9, 1951) In Russian.

First of a series on the latest discoveries relating to the fundamental particles. The authors analyse their experimental results, disclosed between 1947 and 1950, which led them to conclude that there exist various masses, different from the masses of the electron, proton, meson or μ -meson, and to which they gave a general name the "varitrons." A considerable part of the paper is devoted to the answer to the criticism by J. Daudin [Abstr. 8230 (1950)] alleging that their results may be due to an error caused by the presence of electrons not cut off by the filters. The authors give a detailed analysis of all possible sources of errors, to demonstrate that these errors could not essentially affect their results even in their initial experiments and that they were reduced to an insignificant factor in their latest experiments where the methods were essentially perfected. The apparatus is described in some detail, especially their latest mass spectrometer, where the field used in the experiments was up to 10 500 oersted, with 100×30 cm pole faces and 12 cm interpole. In this field five double layers of mutually perpendicular counting tubes were installed, one at the entrance, one at the end and three in between. Apart from this, a number of absorbing screens, such as lead or graphite slabs, were installed at the end of the particle trajectories,

after passing the field with the layers of counting tubes between them and at their sides. In this way the trajectory of each particle before and after its absorption could be studied in detail. The weight of the spectrometer was about 76 tons. As a result of the statistical analysis of the spectra of the masses thus obtained, the authors succeeded, with the aid of their apparatus installed at 3250 m above sea level, in segregating groups of particles with the mass $270 m_e$ and in detecting particles with masses 500–600 m_e and 900–100 m_e . N. S. JAPOLSKY

539.18 : 537.591.1

6772. On the existence of the "varitrons." S. N. VERNOV, N. A. DOBROTIN AND G. T. ZATSEPIN. *Zh. Eksper. Teor. Fiz.*, **21**, 1045–61 (No. 9, 1951) In Russian.

Criticizes the experimental results obtained by Alikhanyan and Alikhanov in their work on cosmic rays, and more particularly their conclusions about the existence of many kinds of fundamental particles which they called "varitrons" (preceding abstract). In the opinion of the authors, the "showers" and spurious trajectories, and also the electrons resulting from the ionization and from the nuclear disintegration in the absorbing screens, which, in particular, can be caused by the π -mesons, have not been adequately eliminated, not only in the first series of the experiments, whose results, in a considerable proportion, were not borne out by the later experiments with the aid of an improved mass spectrometer, but also in the latter set, in spite of the improvements in the apparatus. Furthermore, it is their opinion that after the proper elimination of these obscuring factors, the apparent maxima in the mass spectroscopic curve, which were interpreted as the records of the varitrons, will not go beyond the limits of statistical distribution of deviations and errors, so that in reality they should not be interpreted as a proof of the presence of particles of corresponding masses. N. S. JAPOLSKY

539.18 : 537.591.1

6773. On the article by S. Vernov, N. Dobrotin and G. Zatsepin. A. I. ALIKHANYAN, *Zh. Eksper. Teor. Fiz.*, **21**, 1062–7 (No. 9, 1951) In Russian.

A detailed answer to the criticism of the experimental work by the author and Alikhanov on "varitrons" (preceding abstracts). The author, in his counter-argument, points out that some of the criticized results obtained by himself and his associates in 1946 were later independently confirmed by quite different methods (photographic emulsion) by Powell, who detected exactly the same particles as they did, and gave them the name of the " π -mesons," while the improved experimental methods, which they used in 1950, has also been followed on similar lines, by the team of physicists headed by Blackett. Furthermore, the author argues that his critics quite arbitrarily eliminated some of the experimental results, and that this led to wrong conclusions. While the improved method of observations showed the necessity of revising some of the initial results, as had been readily admitted in the criticized papers, the essence of the conclusions about the nature of the varitrons has been borne out. Many of the new results, however, still remain unexplained and require further investigation. N. S. JAPOLSKY

6774. Small-angle distribution of 3.27 MeV neutrons scattered by deuterons. I. HAMOUDA AND G. DE MONTMOLLIN. *Helv. Phys. Acta*, **25**, 107-18 (No. 1-2, 1952) *In French*.
The angular distribution of 3.27 MeV (*d, d*)-neutrons scattered by protons and deuterons, have been investigated in the cloud chamber. 4000 proton recoils as well as 4000 deuteron recoils have been photographed and measured. The investigation covered the angular range $\theta = 18^\circ - 70^\circ$, where θ = neutron scattering angle in C.M. system. The angular distribution of the neutron-proton scattering was found to be isotropic throughout the investigated angular range, which suggested the reliability of the measurements in the case of the neutron-deuteron scattering. The angular distribution data were made to join with the data of a former experiment to represent the angular distribution throughout the range from 18° to 180° . The experiment shows a pronounced maximum at 0° , a minimum around 90° and a smaller maximum at 180° . [See Abstr. 564 (1952) for preliminary communication.] A.
- 539.185
6775. On the emission of neutrons by samarium. A. NAHMAS. *C.R. Acad. Sci. [Paris]* **234**, 1763-5 (April 28, 1952) *In French*.
Using BF_3 proportional counters no trace of neutron emission by 1 kg of Sm_2O_3 could be found, in contrast to the results of Yagoda and Kaplan (Abstr. 527 (1950)). A. O. STANESBY
- 539.185
6776. Scattering of protons by the loosely bound neutron in beryllium. K. STRAUCH AND J. A. HOFMANN. Letter in *Phys. Rev.*, **86**, 563-4 (May 15, 1952).
The energy distributions and yields of neutrons, produced by 112-MeV proton bombardment of Be and C, were measured at several different angles. The "bound" *n-p* differential cross-section was determined by subtracting the effect of the Be^8 core (i.e. $(8/12)^3 \times$ the C spectrum) from the Be spectrum at each angle. The results indicate that the "bound" is lower than the free *n-p* cross-section. T. G. PICKAVANCE
- 539.185
6777. The theory of the impulse approximation. S. T. EPSTEIN. *Phys. Rev.*, **86**, 836-7 (June 15, 1952).
An integral equation is derived for the scattering of a neutron by a bound proton. This equation has the impulse approximation as the first approximation to its solution. The connection between the impulse approximation and the Fermi approximation is discussed and clarified. A.
- 539.185
6778. The scattering of fast neutrons by wolfram. E. E. MANDEVILLE, C. P. SWANN AND F. J. SEYMOUR. *Phys. Rev.*, **86**, 861-2 (June 15, 1952).
Employing good geometry, homogeneous fast neutrons of energy 4.3 MeV, supplied by the *d-d* reaction in the Bartol Van de Graaff statitron, have been scattered in W. Using binocular microscopes and Eastman NTA plates, fields of view were examined to obtain 2700 acceptable recoil proton tracks. The distribution in energy of the inelastically scattered neutrons is obtained. It is roughly estimated that the inelastic scattering cross-section at 4.3 MeV is less than three-fourths as great as the elastic one. A.
- 539.185
6779. The thermal neutron diffusion length in a heterogeneous pile. G. N. PLASS. *J. Appl. Phys.*, **23**, 621-4 (June, 1952).
The diffusion equation for thermal neutrons in a pile with finite sides and having a 3-dimensional lattice structure of fissionable material and moderator is solved to the first 3 orders by an expansion in spherical harmonics. This solution is used to calculate the difference in thermal utilizations of a pile of infinite extent and one with finite sides. From this difference is calculated an accurate expression for the diffusion length in a pile having a lattice structure. This expression is compared with the usual simplified equation for the diffusion length. The leakage of neutrons from a pile is also obtained from this calculation. A.
- 539.185
6780. Neutron-proton scattering at 156 ± 3 MeV. T. C. RANDLE, A. E. TAYLOR AND E. WOOD. *Proc. Roy. Soc. A*, **213**, 392-9 (July 8, 1952).
The angular distribution for neutron-proton scattering at 156 ± 3 MeV has been determined for centre-of-mass scattering angles between 50° and 178° . The ratio $\sigma(\pi)/\sigma(\frac{1}{2}\pi)$ is 5.0, and the minimum value of the differential cross-section occurs at an angle between 75° and 85° . A.
- 539.185.08
6781. Measurement of neutron densities with crystals of NaI(Tl). B. GRIMELAND. *Phys. Rev.*, **86**, 937-9 (June 15, 1952).
Crystals of NaI(Tl) were irradiated in a nuclear reactor and the induced activity in sodium and iodine registered with a photomultiplier tube. It was found that an absolute measurement of the activities can be made in this way. Since sodium is an almost pure "one over v " absorber the neutron density can be determined from its activity. Comparisons have also been made between the sodium and iodine cross-sections for capture of thermal neutrons. With the sodium cross-section equal to 0.47 barn, the cross-section of iodine was found to be 5.00 barns. A.
- 539.185.08
6782. A fast neutron detector. W. F. HORNYAK. *Rev. Sci. Instrum.*, **23**, 264-6 (June, 1952).
A fast neutron detector with an efficiency of a few per cent and the capability of detecting neutrons in the presence of intense γ -ray backgrounds has been developed. The detector consists of a ZnS and Lucite moulded cylinder used in conjunction with a 5819 photomultiplier tube. This detector is well suited to experiments requiring "good geometry" and pulse speeds of the order of 0.1 μsec . A.
- 539.185.08
6783. Neutron flux and spectrum measurement. M. J. POOLE. Letter in *Proc. Phys. Soc. [Lond.] A*, **65**, 453-4 (June, 1952).
An anthracene crystal (0.43 g) and photomultiplier

was used to measure neutron energies by observing the scintillation pulse distribution due to knock-on proton excitation of the anthracene. For 2.54-MeV neutrons the distribution has a half-width of about 20%. Absolute measurement of neutron flux with the system compared well with that from nuclear photographic plate analysis. G. F. J. GARLICK

539.185.08

6784. Survey methods for slow neutrons. B. J. MOYER. *Nucleonics*, 10, 14–17 (April, 1952).

The use of BF_3 counters and ionization chambers in the measurement of slow neutron fluxes is discussed briefly. The foil activation method is also considered.

L. R. SHEPHERD

STRUCTURE OF SOLIDS 539.2

539.21

6785. Physical constants of isotropic solids. T. VENKATARAYUDU AND T. S. G. KRISHAMURTY. Note in *Acta Cryst.*, 5, 287 (March, 1952).

Jahn's results can be derived from group characters

using the formula
$$n_i = \frac{1}{2\pi} \int_0^\pi (\chi'_+ \chi_- + \chi'_- - \chi_+) d\phi$$

where $\chi'_\pm$ stands for the character of the physical property and $\chi_\pm = 1 \pm \cos \phi$, the upper sign relating to rotations and the lower sign to rotation reflections. In the case of elasticity, this gives $n_i = 2$. For solids possessing only symmetry R_∞ , the formula takes the

form
$$n_i = \frac{1}{\pi} \int_0^\pi \chi'_+ \chi_- d\phi.$$

H. J. H. STARKS

539.21

6786. On the kinetics of ordering in Ni_3Mn . L. R. ARONIN. *J. Appl. Phys.*, 23, 642–3 (June, 1952).

Kinetic behaviour in specimens initially cooled through the ordering range is studied as a function of subsequent prolonged isothermal heat treatments. Room temperature measurement of electrical resistivity and saturation induction give evidence substantiating existence of ordered domains. Anomalous kinetic behaviour at intermediate ordering temperatures is interpreted as due to growth of antiphase nuclei. Equilibrium values attainable at low-ordering temperatures and multi-valued correspondence between resistivity and magnetic data exhibit dependence upon extent of domain growth. A.

539.213.1 : 537.226.2

A study of the electrical properties of glasses in relation to glass structure. See Abstr. 6492

539.215.4 : 531.753

6787. A sedimentation balance for particle size analysis in the sub-sieve range. W. BOSTOCK. *J. Sci. Instrum.*, 29, 209–11 (July, 1952).

A method is described for estimating the particle size distribution (Stokes' diameters) of insoluble powders in the sub-sieve range. The powder is dispersed in a suitable liquid and the particles allowed to settle on to the pan of a torsion balance. The

cumulative weight settled is read at chosen time intervals by direct deflection of the torsion wire. An alternative method is to use the return twist of the torsion wire. The size distribution by weight within the particulate mass is deduced from the curve relating the cumulative weight with time, the procedure adopted for calculation being described. The method is simple and speedy and can be operated by relatively unskilled labour. A.

539.215.4 : 535.43

6788. The physics of particle size measurement. II. Optical methods and light scattering. P. G. W. HAWKSLEY. *B.C.U.R.A. Bull.*, 16, 117–47 (April); 181–209 (May, 1952).

Pt I dealt with fluid dynamics [see Abstr. 9738 (1951)]. The present paper is a very complete review of the present position and has a bibliography of over 200 articles. Optical microscopy is discussed with particular reference to its limitations for particles of diameter less than 2 microns. Turbidimetry and nephelometry are discussed and their application to optical sedimentometers. A detailed treatment of the theory of light scattering is given together with a discussion of the numerical examples which have been computed and a comparison with such experimental data as is available. A correction is given to Pt I of this review. J. M. HOUGH

539.217

6789. The effect of four transition metals on the α/β brass type of equilibrium. J. B. HAWORTH AND W. HUME-ROTHERY. *Phil. Mag.*, 43, 613–29 (June, 1952).

Cu is able to dissolve both Zn and Al, and in these binary systems Cu–Zn and Cu–Al there are typical primary (α) face-centred-cubic solid solutions, and body-centred-cubic (β) phases, which are 3/2 electron compounds. In these and other similar alloys of Cu, the equilibrium between the α and β phases is determined mainly by the electron concentration, provided that the size-factors are favourable and the electrochemical factors are small. The present paper describes an experimental investigation of the effect of Mn, Fe, Co and Ni on the α/β equilibrium in Cu–Zn and Cu–Al alloys at 672°C. For this purpose three isothermal sections of the ternary systems in these regions concerned have been determined by the method of annealing and microscopical examination. If it is assumed that the $\alpha/(\alpha + \beta)$ and $(\alpha + \beta)/\beta$ solubility curves in the ternary isothermal sections are lines of constant electron concentration, the results show that, when present in small quantities, Ni, Co, Fe and Mn act as though they possessed valencies of about 0.6, 0.8, 1.0 and 1.9 respectively, in the systems Cu–Zn–Ni, Cu–Zn–Co, Cu–Zn–Fe, Cu–Zn–Mn, Cu–Al–Co, Cu–Al–Fe and Cu–Al–Mn. If the simple collective electron theory is assumed, the apparent valencies for Ni, Co and Fe are approximately equal to the numbers of s-electrons per atom in the crystals of the metallic elements concerned. For manganese the apparent valency agrees with the divalent state previously proposed for this element. The results for the system Cu–Al–Ni are anomalous. The bearing of these results on the theory of the transition metals and their alloys is discussed. A.

539.217
 790. Determination of the transverse permeabilities of large core samples from petroleum reservoirs. E. COLLINS. *J. Appl. Phys.*, **23**, 681-4 (June, 1952). The solution of the problem of determining the permeabilities of petroleum reservoir rocks from measurements employing the flow of a gas through large cylindrical cores, transverse to the axis of the cores, is presented. This solution is obtained by solving the corresponding problem in potential theory, the method of conformal transformations of complex variables being employed. An electrolytic model study of this problem is described and a comparison of the theoretical and experimental solutions presented. A.

539.217
 791. Effects associated with the flow of vacancies in intermetallic diffusion. R. S. BARNES. *Proc. Phys. Soc. [Lond.] B*, **65**, 512-25 (July, 1952). Experiments on the interdiffusion of Cu- α -brass and Cu-Ni couples and sandwiches have shown that there is an increase of volume in the diffusion zone as a result of diffusion. This increase in volume is associated with the formation, in the diffusion zone, of voids with crystallographic faces. These voids appear near to the original interface and on that side from which there is a net loss of atoms, or a net gain of vacancies, as shown by the movement of inert markers. Grain boundaries influence the movement of the markers in regions where there has been preferential grain-boundary diffusion. A close micrographical examination of the diffusion zone shows it to have an unusual structure, various observations pointing to the presence of strain, and X-ray back-reflection photographs of a Cu-Ni couple show that the diffusion zone is polygonized. Subsidiary experiments suggest how strain in the diffusion zone arises. A vacancy diffusion mechanism where there is a preferential flow of vacancies in the one direction, is used to explain the above phenomena. This flow will produce strain in the diffusion zone if vacancies are generated on one side of the original interface and collapse on the other. Mechanisms are discussed for the generation and condensation, within the diffusion zone, of the large numbers of vacancies necessary for the process. To explain the volume increase and formation of voids it is postulated that not all the vacancies on the one side of the interface are eliminated by the lattice collapsing, but that some vacancies coalesce to form microscopic voids which enlarge by assimilating further vacancies. A.

539.217 : 536.21 : 537.311.31

792. Thermal and electrical conductivity of porous metals made by powder metallurgy methods. P. GROOTENHUIS, R. W. POWELL AND R. P. TYE. *Proc. Phys. Soc. [Lond.] B*, **65**, 502-11 (July, 1952).

Measurements are reported of the thermal conductivity and electrical resistivity over the range of 0°C to 200°C on several specimens of a sintered porous bronze material (89% Cu, 11% Sn). The constituent powder particles were subsequently spherical in shape and the specimens studied covered particle diameters ranging from 0.00133 to 0.040 cm and had densities from 5.27 to 7.01 g/cm³. The modified Lorenz relationship between the thermal

conductivity K , the electrical resistivity ρ and the absolute temperature T was found to apply, the experimental results satisfying the straight line $K = 0.58 \times 10^{-8} T / \rho + 0.005$. Existing data for solid bronzes of similar composition also conformed to this line. It is shown that, to a first approximation, the conductivities are independent of the particle size of the powder from which the specimen has been made, but can be correlated to a density basis, the values falling along a straight line drawn from the point for the solid material to cut the abscissa at a density corresponding to the maximum porosity which can be attained on packing equal-sized spheres. This method of correlation is also confirmed by data from the literature for the electrical conductivity of Cu, Ni and Fe. Suggestions are made for estimating the thermal conductivities of similar porous materials. A.

539.27
 6793. Electron microscopic determination of size and shape of a new plant virus (sann hemp mosaic). M. L. DE. *Indian J. Phys.*, **25**, 525-9 (Nov., 1951).

539.27
 6794. Electron microscope study of plasticized latices. E. B. BRADFORD. *J. Appl. Phys.*, **23**, 609-12 (June, 1952).

Silicon monoxide replicas of the surfaces of air dried films are shown which were cast from a Saran latex containing various amounts of plasticizer. It can be observed that the poor films are composed of discrete individual particles while in a continuous transparent film the particles have coalesced into a polymeric mass. Replicas of surfaces of films are shown which were produced from different types of synthetic latices before and after they had been plasticized. A.

539.27
 6795. Recovery of electron microscope grids. G. EAVES. Letter in *Nature [Lond.]* **169**, 975-6 (June 7, 1952).

539.27
 6796. The cross-striations of collagen fibrils. W. GRASSMANN, U. HOFMANN AND T. NEMETSCHKE. Note in *Naturwissenschaften*, **39**, 215-16 (No. 9, 1952) In German.

Electron micrographs of preparations from cat's-tail tendon, stained with phospho-tungstic acid, show 10 or 11 striations within the main period of 750 Å. A greater resolution is achieved than has hitherto been demonstrated in biological material, some of the substriations corresponding to regions containing only 7-10 amino-acids. A microphotometer record of an electron micrograph is given. J. THEWLIS

539.27 : 539.434
 6797. An electron-microscope study of the effect of temperature and strain-rate on the mechanism of deformation of aluminium. R. I. GARROD, J. W. SUITER AND W. A. WOOD. *Phil. Mag.*, **43**, 677-85 (June, 1952).

Formvar and oxide replicas have been prepared from polycrystalline specimens deformed plastically over a range of temperatures and rates of strain. Electron microscope observations support the view, put forward previously by Wood, Wilms and Rachinger [Abstr. 5839 (1951)], that there are three

basic stages in the mechanism of the deformation of metals, which have been termed the slip, cell and boundary micro-flow processes. If the temperature and rate of strain are adjusted suitably, no sign of slip is visible in the cell stage even with the high resolution available with electron microscopy. Correspondingly, in the boundary micro-flow stage, there is no evidence of any internal breakdown or disorientation of the grains. In both the cell and boundary micro-flow stages, however, considerable activity occurs at the grain boundary zones, which exhibit markings similar in appearance to slip but always approximately parallel to the boundary direction. Interpretation in terms of structural changes and their possible relationship to the dislocation theory of deformation are discussed briefly.

A.

ELASTICITY . STRENGTH . RHEOLOGY
539.3/8

539.31

6798. A new theorem in the classical theory of elasticity. A. S. LODGE. Letter in *Nature* [Lond.] 169, 926-7 (May 31, 1952).

A type of "transversely isotropic" elastic solid is considered, in which the five elastic constants satisfy two special conditions. Any problem concerning the equilibrium of a body in which the direction of elastic symmetry is the same everywhere is convertible into one for an isotropic solid by simple changes of scale in co-ordinates, displacements and stresses.

J. G. OLDROYD

539.31

6799. Experiments on the mechanics of rubber. II. The torsion, inflation and extension of a tube. A. N. GENT AND R. S. RIVLIN. *Proc. Phys. Soc.* [Lond.] B, 65, 487-501 (July, 1952).

The formulae derived by Rivlin in Pt I for the forces necessary to produce simple extension, radial inflation and torsion in a tube of incompressible highly elastic material, which is isotropic in its undeformed state, are specialized to the case when the amount of torsion is small. The resulting formulae are compared with measurements on tubes of vulcanized natural rubber and conclusions as to the form of the stored-energy function are drawn, in general agreement with those reached from earlier experiments. The experiments indicate that hysteresis between the loading and unloading curves for the vulcanizate is associated with certain terms in the expression for its stored-energy function and, presumably, with the mechanism which accounts for the presence of these terms.

A.

539.319

6800. The effect of transformation stress on specific volume of iron at A_3 point. M. SATO. *Proc. Japan. Acad.*, 26, 11-13 (Oct., 1950).

According to Honda (1949) the α - γ transformation in iron is characterized by an internal stress of 2000 atmospheres. The calculated change in specific volume due to this is 0.3% which agrees with the value observed by S. Satô (1925).

M. R. HOPKINS

539.319 : 548.0 : 534.321.9

6801. Effect of ultrasound on stress distribution in a monocrystal of a solid solution of the bromide and iodide of thallium. M. V. KLASSEN-NEKLYUDOVA AND A. P. KAPUSTIN. *Dokl. Akad. Nauk SSSR*, 77, 1019-22 (No. 6, 1951) In Russian.

539.323

6802. The temperature-dependence of Poisson's ratio in metals. F. VITOVEC. *Öst. Ingen.-Arch.*, 6, 132-4 (No. 2, 1952) In German.

The temperature dependence of Poisson's ratio is computed from the modulus of elasticity and then compressibility. Sufficient experimental data exist for the temperature dependence of the modulus of elasticity. The temperature dependence of the compressibility is computed from the lattice energy. Poisson's ratio and the temperature gradient rises when the temperature is increasing.

A.

539.323

6803. Measurement of Young's modulus of metal bars by an electromagnetic method. J. SAVORNIN AND G. RENUCCI. *C.R. Acad. Sci. [Paris]* 234, 2045-6 (May 19, 1952) In French.

The method applies equally to magnetic and non-magnetic metal rods. An alternating magnetic field near one end induces currents in the rod, which is supported centrally by a rubber ring, and hence gives rise to a repulsive force varying with twice the field frequency. The amplitude picked up by a telephone receiver loosely coupled to the other end has a sharp maximum at the resonant frequency of the rod, from which the modulus can be deduced. The method gave the value $(5.67 \pm 0.05) \times 10^{11}$ dyne cm^{-2} for the Young's modulus of Cd.

J. G. OLDROYD

539.33

6804. The change of the elastic constants of β -brass with composition. H. JONES. Letter in *J. Appl. Phys.* 23, 697 (June, 1952).

An observed decrease in $\frac{1}{2}(c_{11} - c_{12})$ when the Cu concentration is increased has been attributed by Artman and Thompson [Abstr. 3817 (1951)] to an increase in the non-Coulomb ion-ion interaction; but this cause would increase c_{44} and the bulk modulus which are also observed to decrease. Reasonable agreement with experiment is obtained on the basis of the author's theory [Abstr. 2166 (1952)] of the effect on the Fermi energy of the conduction electrons due to shearing of the Brillouin zone, taking into account the changes in electrostatic contribution to shear constants.

J. G. OLDROYD

539.37

6805. The formation of immobile dislocations during slip. A. H. COTTRELL. *Phil. Mag.*, 43, 645-7 (June 1952).

Lomer has pointed out that certain dislocations or intersecting slip planes in the face-centred cubic lattice can join to form new dislocations. It is now proposed that these new dislocations dissociate into groups of imperfect dislocations which cannot move because of the arrangement of their associated stacking faults. These immobile dislocations may be important in work hardening.

539.373
66. Elementary structure and slip band formation in aluminium. D. KUHLMANN-WILSDORF, J. H. VAN DER MERWE AND H. WILSDORF. *Phil. Mag.*, **43**, 32-44 (June, 1952).

From electron micrographs of deformed high-purity Al numerical estimates for the spacing, length and amount of glide of the individual elementary dislocations have been obtained. It is found that the latter two quantities are compatible with the conception that each line is formed by dislocations emitted from the freely acting source of dislocations. The existing experimental evidence relating to the problem whether or not slip starts at the crystal surfaces is discussed. The evidence suggests that the sources of dislocations might well lie at the surfaces and therefore it is considered possible that the elementary structure is confined to a surface layer. The observed spacing of the steps, in the elementary structure as well as in the slip bands, is comparable with the theoretical critical distance below which rows of dislocations cannot pass each other. This indicates that there are many more possible sources than become active. A mechanism for the development of slip bands out of the elementary structure is proposed. This mechanism entails the annihilation of all dislocations in the immediate neighbourhood of an expanding slip line.

A.

539.374
807. The application of Nutting's equation to the viscoelastic behaviour of certain polymeric systems. F. W. SCOTT BLAIR. Letter in *J. Appl. Phys.*, **23**, 100 (May, 1952).

The general validity of Buchdahl and Nielsen's [Abstr. 585 (1952)] relation between creep function and dissipation factor is criticized.

J. E. CAFFYN

539.374
808. The application of Nutting's equation to the viscoelastic behaviour of certain polymeric systems. R. BUCHDAHL AND L. E. NIELSEN. Letter in *J. Appl. Phys.*, **23**, 600 (May, 1952).

Reply to criticism (see preceding abstract).

J. E. CAFFYN

539.374
809. On the significance of the limit load theorems for an elastic-plastic body. E. H. LEE. *Phil. Mag.*, **43**, 49-60 (May, 1952).

The limit load theorems of Drucker, Greenberg and Prager [*Brown University Technical Report No. 61* (1951)] for an elastic-plastic material flowing under constant surface tractions are contrasted with the theory of the yield of a plastic-rigid body [Hill, Abstr. 8267 (1951)]. Plastic-rigid theory is interpreted, as it must be for application to actual materials, as a model providing an approximation which can reasonably be expected to be satisfactory when plastic strains large in comparison with elastic strains have occurred. It is shown by the discussion of particular examples that the limit load for an elastic-plastic body is in general reached or closely approached while strains throughout are of the order of elastic strains, and at this stage the limit load theorems can be applied. Examples are cited to show that if plastic-rigid analysis is adopted, and strains large compared with elastic strains must be attained,

the influence of boundary motion may invalidate application of the yield limit theory in circumstances when the limit load theorems for an elastic-plastic material provide significant results. It is shown that the uniqueness and variational theorems applicable to a plastic-rigid material at yield, apply to an elastic-plastic material at the limit load, thus permitting stress distribution in an elastic-plastic body to be determined on the basis of plastic-rigid theory. Examples are cited.

A.

539.374
6810. Comments on Dr. Lee's paper. R. HILL. *Phil. Mag.*, **43**, 560-1 (May, 1952).

539.374
6811. Plastic flow in alkali halide crystals. W. W. TYLER. Letter in *Phys. Rev.*, **86**, 801 (June 1, 1952).

It is suggested that the large increases in conductivity of NaCl, KCl and KBr single crystals when subjected to very large stresses may be in part due to electronic processes, and not solely to the creation of vacancies or interstitials which cause an increased ionic conduction.

C. A. HOGARTH

539.378.6 : 539.16.08
6812. On the advantage of radioactive tracers in the study of the wear of laminated plastics. M. EZRAN. *C.R. Acad. Sci. [Paris]* **234**, 1947-9 (May 12, 1952) In *French*.

A plastic roller was impregnated with NaCl and irradiated with pile neutrons. The method gave a very quick and accurate measurement of wear.

F. R. HOLT

539.388.22
6813. A study of tracer methods for assessing wear of wire-drawing dies. J. C. E. BUTTON, A. J. DAVIES AND R. TOURRET. *Nucleonics*, **9**, 34-43 (Nov., 1951).

A method for studying the deposition of debris from a tungsten carbide die on a copper wire drawn through the die, is described. The die was irradiated in a pile neutron flux to produce 5.3 yr Co^{60} , 76 day W^{185} and 24 day W^{187} activities. The drawn wire was examined for activity by 3 methods: autoradiography of 10 in lengths; measurement of activity deposited on a cathode as a result of electrolytic stripping of the surface of the wire as it was slowly fed through an electrolyte; direct counting in a G.M. tube with the wire wound round it in a close helix. The autoradiographs showed signs of fairly uniform activity along the wire, attributed to Co^{60} , with discrete spots of higher activity attributed to tungsten carbide particles. The rate of wear indicated was in good agreement with estimates ($2 \times 10^{-8} \text{ g/ft}$) based on the increase of bore of dies in industrial use.

L. R. SHEPHERD

539.4.016.3
6814. A study of the annealing kinetics in cold worked copper. D. BOWEN, R. R. EGGLESTON AND R. H. KROPSCHOT. *J. Appl. Phys.*, **23**, 630-4 (June, 1952).

The resoftening kinetics for cold work in Cu were studied using residual resistance as a measure of the degree of recovery. The specimens were quickly heated to the annealing temperature, held at temperature for a measured time, and quenched for measurement. It was assumed that the cold work could be characterized by a number of lattice defects n and that

the residual resistance change produced by these defects obeyed Matthiessen's rule. It was found that the resoftening could be represented by a single process of activation energy 28.3 kcal per mole. The complete annealing kinetics are described by a 4th-order reaction, $dn/dt = -vn^4e^{-E/RT}$. A.

539.4.016.2

6815. X-ray line broadening of plastically deformed marble. D. ROSENTHAL AND M. KAUFMAN. Letter in *J. Appl. Phys.*, **23**, 600-1 (May, 1952).

X-ray line broadening after cold work may be due either to (1) fragmentation of the crystals to much smaller crystallites, or (2) lattice distortion. The properties of marble are such that it may be powdered after plastic deformation without introducing further cold work. Since such powdering allows relaxation of any residual stresses introduced, the fact that the line broadening was found almost to disappear below a certain particle size ($\sim 1 \mu$) is interpreted as meaning that (2) is its predominant cause.

A. D. LE CLAIRE

539.42

6816. Conical surfaces of fracture produced by asymmetrical impulsive loading. J. S. RINEHART AND J. PEARSON. *J. Appl. Phys.*, **23**, 685-7 (June, 1952).

Conical surfaces of fracture generated in thick-walled cylinders that were asymmetrically and impulsively loaded through the use of internal explosive charges are presented. It is deduced from qualitative considerations that the conical fractures result from the interaction between transient tensile stress waves. The two tensile stress waves that are responsible for the fracture arise from a single compressional stress wave that is reflected from two inclined free surfaces. The angle of fracture associated with these conical surfaces has been used to measure the velocity of propagation of the stress waves in low-carbon steel, brass, Cu, Pb and 24ST Al alloy. A.

539.42

6817. A method of studying the formation of cracks in a material subjected to stress. R. JONES. *Brit. J. Appl. Phys.*, **3**, 229-32 (July, 1952).

While the loads were being applied, measurements were made at intervals of the velocities of ultrasonic pulses passing through the test-piece in the axial and/or transverse directions. In compression, the velocity of the ultrasonic pulses in the direction of loading remained constant while the load was increased to failure, but in the transverse direction a fall in the velocity started at only a fraction of the ultimate load, and the velocity then decreased with increase of load. This indicated that cracking occurred internally parallel to the direction of loading. The load at which it started depended on the strength of the concrete and the uniformity of the stress distribution. In tension, fracture was preceded by only a very small, and often insignificant, amount of cracking which occurred at right angles to the direction of loading. A.

539.42 : 539.211

6818. The fractures produced in glass and plastics by the passage of stress waves. D. G. CHRISTIE AND H. KOLSKY. *J. Soc. Glass Techn.*, **36**, T65-T73 (Feb., 1952).

The fracture phenomena observed in specimens of

glass and plastics when small quantities of explosive were detonated in contact with them or when they were hit by high-speed projectiles are described. It is shown that the nature of the fractures produced by stress waves differs in several important respects from that found statically, and that many of the phenomena may be explained in terms of the theory of the propagation of stress waves in solids and of their reflection at free boundaries. A.

539.42 : 539.211

6819. An investigation of cracks and stress waves in glass and plastics by high-speed photography. D. G. CHRISTIE. *J. Soc. Glass Techn.*, **36**, T74-T89 (Feb., 1952).

A high-speed spark camera is described which will take a series of nine photographs at rates of 20 000 to 200 000 frames per second. The camera has been used to photograph the propagation of stress waves and the formation of cracks in sheets of glass and Perspex. The illustrated results show the effects of applying pressure pulses of from 2 to 40 μ sec duration to small plates of the materials. The reflection of the stress waves from the free edges of the plate is discussed with particular reference to the formation of fractures. Finally, the type of *hackle* structure appearing on some of the fracture surfaces is discussed in relation to the method of formation of the cracks. A.

539.42 : 539.56

6820. Delayed fracture of metals under static load. N. J. PETCH AND P. STABLES. Letter in *Nature [Lond.]* **169**, 842-3 (May 17, 1952).

If the H embrittlement of Fe depends upon H adsorption on the new surfaces resulting from the time-dependent extension of Griffith cracks, then the embrittlement must vary with the rate of loading. This has been confirmed: for rapid loading there is little difference in the behaviour of H-free and H-charged specimens, but in a slower test (minutes) a distinct embrittlement is observed. A. J. KENNEDY

539.43

6821. Influence of structure on the plastic flow of steel above the A_3 point. P. FELTHAM. Letter in *Nature [Lond.]* **169**, 976 (June 7, 1952).

The rate of strain at any given temperature, for a fixed stress, determined from experiments in which the flow took place under conditions of rising temperature, was greater than that found from experiments at constant temperature, except above 1150°C where the two are equal. The discrepancies are attributed to the establishment of a characteristic grain size in the latter experiments, not achieved at the lower temperatures in the former experiments. An equation is given relating the constant temperature strain rate with temperature and stress. A. D. LE CLAIRE

539.434

6822. On the theory of creep in single crystals. O. G. FOLBERTH AND A. KOCHENDÖRFER. Note in *Naturwissenschaften*, **39**, 187-8 (No. 8, 1952) In German.

Assuming the number of lattice vacancies governs the rate at which dislocations disappear, an approximate expression is derived for comparatively large creep rates. J. E. CAFFYN

539.501 : 536.48

23. **Mechanical properties of metals at low temperatures.** *Circ. Nat. Bur. Stand., No. 520, 206 pp.* (1952).

This volume presents results of studies conducted both in industry and in government to further knowledge of the behaviour of metals at low temperatures, which is important to an understanding of their fundamental rheological properties. The papers were initially presented at the Symposium on the Influence of Low Temperatures on the Mechanical Properties of Metals held at the National Bureau of Standards on May 14 and 15, 1951. Papers included in the volume cover recent European work in the field; manufacture of steels, development and application of chromium-copper-nickel steel, and application to metals in aircraft for low-temperature service; ductile properties of copper, nickel, and some copper-nickel alloys, properties of austenitic stainless steels, and mechanical properties of high-purity iron-carbon alloys at low temperatures; dimensional effects in structure; and brittle fractures in ship plates.

539.53 : 535.551

24. **A photoelastic investigation of the hardness of plastics and glass.** H. KOLSKY. *J. Soc. Glass Techn.*, **35**, T56-T64 (Feb., 1952).

The nature of the stress distribution set up when a cylindrical indenter is pressed into a plane surface has been investigated photo-elastically. When the

shear stress does not exceed anywhere the elastic limit of the material the distribution agrees with Hertz's mathematical treatment. For higher applied stresses plastic flow occurs some distance below the surface. It is this flow which results in the permanent indentation of the surface layers in which the stress may not have exceeded the elastic limit. For "Perspex" a linear relation exists between the birefringence and the strain far beyond the elastic limit, and the behaviour of this material could thus be studied even after plastic distortion had taken place. This property of "Perspex" should be of importance in other problems of stress analysis. With brittle materials, such as glass, failure occurs under tension rather than shear stress, and here the photo-elastic technique has been used to study the stress distribution before and after the specimens cracked. A.

539.533

6825. **"Elastic" and "plastic" hardness of hard materials.** P. GRODZINSKI. Letter in *Nature [Lond.]* **169**, 925-6 (May 31, 1952).

Account is taken of the elastic deformation, which is not normally observed in a micro-hardness test, as well as the plastic deformation of the test-piece, in assessing hardness. An evaporated Ag film about 0.1 micron thick, on the surface of (e.g.) synthetic ruby, makes the elastic deformation visible. A correction is made for the thickness and loading of the Ag. J. G. OLDROYD

PHYSICAL CHEMISTRY 541

PHASE EQUILIBRIUM . CHEMICAL REACTIONS 541.11/.12

541.123.5

26. **Mass spectrometric determination of the deuterium-tritium equilibrium.** H. C. MATTHEW, C. F. MACHUCKI AND L. M. DOREMAN. Letter in *J. Chem. Phys.*, **20**, 926 (May, 1952).

The mean of five values of $K_e = (HT)^2/(H_2)(T_2)$ is 2.87 ± 0.06 , after establishment of isotopic equilibrium at 28°C in mixtures of various compositions. The sensitivities for H_2 , D_2 and T_2 were equal within <2%. T. G. PICKAVANCE

541.123.5

27. **Proton transfers in solution.** A. NISONOFF, P. KUHN AND R. W. GURNEY. *J. Chem. Phys.*, **20**, 935-9 (June, 1952).

By a spectrophotometric method the acid-base equilibrium between bromocresol green and triethanolamine was measured over the range of temperature from -6°C to +50°C in the 3 solvents—methanol, ethanol and *n*-butanol. In each solvent the equilibrium constant was found to vary rapidly with temperature; and in methanol the value of $\log K$ was found to change sign near 0°C. This behaviour is very different from the well-known results for weak acids in aqueous solution, and in the theoretical part of the paper a unified theory is presented to cover all types of proton transfer. The work required to

transfer a proton consists of two parts, a part sensitive to the environment and a part insensitive to the environment; the behaviour of the equilibrium constant depends on whether the two parts are of the same sign or of opposite sign. Families of curves are drawn to show the various possible types of behaviour. A.

541.124

6828. **Steric factor and activation energy of the reaction** $Na + C_2H_5Cl = NaCl + C_2H_5$. R. J. CVETANOVIC AND D. J. LE ROY. *J. Chem. Phys.*, **20**, 1016-20 (June, 1952).

The reaction between atomic sodium and ethyl chloride was studied over the range 260° to 380°C by the diffusion flame method. From the temperature coefficient of the rate constant the activation energy was found to be 10.2 kcal per mole. The maximum uncertainty in this quantity from all causes, is estimated to be ± 0.5 kcal per mole. The steric factor was 1.0 ± 0.3 , based on the customary value assigned to the collision diameter. A.

541.124

6829. **Induced decomposition of acetaldehyde by radicals.** R. K. BRINTON AND D. H. VOLMAN. Letter in *J. Chem. Phys.*, **20**, 1053-4 (June, 1952).

The results of thermal decomposition of a mixture of CH_3CHO and di-*t*-butyl peroxide in the range 124-156°C agree very well with an equation relating the rates of formation of CH_4 and C_2H_6 and derived

from the assumption that the decomposition of CH_3CHO may be induced at temperatures lower than usual by the action of a radical capable of abstracting H.

F. LACHMAN

541.124

6830. High concentration limit of unimolecular reaction kinetics. H. S. JOHNSTON. *J. Chem. Phys.*, **20**, 1103-6 (July, 1952).

A general sum-over-states form of the Lindemann theory of unimolecular reactions is analysed with respect to properties in the high concentration region, and results are compared with similar deductions found in the low concentration region. In a general form the theory can set a limit on the low concentration rate constant from data taken in the high concentration region alone, and it can set a limit on the high concentration rate constant from data taken in the low concentration region alone. If there are data at both the low and high concentration regions, one can compute two dimensionless parameters which are useful in interpreting kinetic data. In particular, these parameters may be used to select the number of oscillators and their frequency in the Rice-Ramsperger-Kassel form of the theory. These methods are applied to nitrogen pentoxide and nitrous oxide.

A.

541.124 : 539.13

6831. A detailed formulation of kinetic processes from the point of view of the activated complex. S. W. BENSON. *J. Chem. Phys.*, **20**, 1064-8 (July, 1952).

By combining Slater's classical treatment for the adiabatic decomposition of an unstable molecule with the Lindemann mechanism for collisional activation it is possible to make a uniform and consistent treatment of kinetic processes of all orders. The high pressure rate constants may then be represented by $k_{\text{obs}} = \alpha \cdot \langle \bar{\nu} \rangle \cdot K^\ddagger \cdot \exp(-E^*/kT)$, where $\langle \bar{\nu} \rangle$ is a root mean square average of the " n " normal modes of vibration of the activated complex, E^* is the minimum energy required for reaction, α is a "transmission coefficient" which is unity for unimolecular processes and between $\frac{1}{2}$ and 1 for higher order reactions, and $K^\ddagger$ can be interpreted in terms of an entropy of activation. A more complicated expression is obtained for lower pressures in the case of unimolecular reactions. The theory is sufficiently detailed to allow predictions on the relation of molecular structure to the pressure region in which collisional activation becomes a limiting rate factor for unimolecular reactions. Similarly predictions may be made concerning the nature of recombination processes and their pressure and temperature dependence. It is shown that recombination processes will have a negative temperature coefficient and in addition the mean life of the activated complex will vary inversely with some power of the strength of the bond being formed. As a result of this, recombination will be more efficient in photochemical or, more generally, low temperature chain reactions than in pyrolytic reactions and consequently chain lengths will be longer in the latter.

A.

541.124 : 539.16.08

6832. Application of the method of radioactive isotopes to the investigation of the mechanism of

chemical reactions. P. DAUDEL. *Bull. Soc. Chim. France*, **19**, 23D-27D (March-April, 1952) In French.

Analyses and illustrates with examples the use of radioactive isotopes in studying chemical reactions, viz. (1) when radioactivity is used as an analytical means in research on chemical kinetics, e.g. of the reaction of reduction of FeS by H at a high temperature, and (2) when radioactive isotopes are used as "labelled" atoms. Three cases of the latter use are discussed in more detail: (a) the atoms studied belong to different molecules, both before and after the reaction ($\text{KIO}_4 + 2\text{KI} + \text{H}_2\text{O} = \text{I}_2 + \text{KIO}_3 + 2\text{KOH}$); (b) the atoms belong to the same molecule before the reaction, but to different molecules after the reaction ($\text{CH}_3\text{CH}_2\text{COO}^- + 4\text{MnO}_4^- = (\text{COO})_2^{--} + \text{CO}_3^{--} + 4\text{MnO}_2 + \text{OH}^- + 2\text{H}_2\text{O}$), and (c) the atoms belong to the same molecule, both before and after the reaction (reaction of Willegerodt; transposition of atoms). Over 60 references are quoted.

541.124

6833. A mechanical theory of spinning detonation. J. A. FAY. *J. Chem. Phys.*, **20**, 942-50 (June, 1952).

The problem is treated principally from a hydrodynamic viewpoint by considering a possible periodic fluid motion with a characteristic frequency. It is found that the calculated natural frequencies of vibration of the gaseous products behind a detonation wave agree closely with the measured frequencies of spinning detonation previously published in the literature. An analysis of such vibrations in the light of experimental evidence indicates that the vibratory motion is principally transverse. Of the various possible modes of vibration, the one which is observed depends upon the mixture composition and the tube size. The observed existence of pressure waves in the wake of a spinning detonation wave is probably due to non-uniform combustion at the detonation front. It is shown how the initiation or cessation of combustion in a plane wave gives rise to compression or expansion waves respectively, and how a nonplanar disturbance excites a transverse vibration of characteristic frequency. It is proposed that the uneven combustion of the spinning detonation wave is sustained by the heating and cooling effects of the vibratory pressure waves, which are themselves generated by such irregular combustion; i.e. spinning detonation is a self-excited vibratory phenomenon. Its appearance may thus be attributed to the susceptibility of the reaction rate to the heating or cooling effects of pressure waves.

541.124

6834. Gaseous detonations. V. Nonsteady waves in $\text{CO}-\text{O}_2$ mixtures. G. B. KISTIAKOWSKY, H. T. KNIGHT AND M. E. MALIN. *J. Chem. Phys.*, **20**, 994-1000 (June, 1952).

For Pt IV, see Abstr. 5377 (1952). The velocity of steady detonation waves in 2.5 $\text{CO}-\text{O}_2$ mixture containing H agrees with the calculations of the Chapman-Jouguet theory. When all sources of H atoms are eliminated from such mixtures, much hotter shock waves must be used to initiate detonation. The detonation waves in H -free mixtures are stable but nonsteady. The velocities observed by piezoelectric pressure gauges undergo violent and not very regular fluctuations similar to, but not identical with, spinning

donations. Moving film slit photographs show that these fluctuations are caused by detonation fronts developing behind the forward shock, overtaking it at irregular intervals and decaying in their stead. Similar detonation fronts are observed in delayed detonations of explosive mixtures capable of stationary detonation, but the waves upon initiation and after a few fluctuations settle into the stationary Chapman-Jouguet regime. Photographic observations show that the detonations developing behind the shock front are initially localized near the opposite walls of the cylindrical tube, while the gauge records demonstrate that the fronts of nonsteady waves are not normal to the tube axis but undergo irregular gyrations. The significance of these observations in terms of the rates of chemical reactions in shock fronts is discussed. A.

541.126

6835. The initiation, burning and thermal decomposition of gunpowder. J. D. BLACKWOOD AND F. P. COWDEN. *Proc. Roy. Soc. A*, 285–306 (July 8, 1952).

There is evidence that initiation is due essentially to the formation of local hot spots; these may be formed by the adiabatic compression of air pockets, by the friction of grit particles and in other ways. The necessary temperature for these hot spots is remarkably low (c. 130°C), but it is sufficient to melt S. It is suggested that the formation of a liquid phase is important and that the process starts with the reaction of molten S with the oxyhydrocarbons present in the charcoal. These oxyhydrocarbons which can be extracted from the charcoal with a suitable solvent, melt at a low temperature and can also provide a liquid phase. A high pressure is necessary before these reactions can proceed at a sufficient rate. A study is made of the way in which the initial reactions develop until the heat evolved is sufficient to start the main reaction, which is the oxidation of C by KNO_3 . There is evidence that the acceleration of the initial reaction which leads up to the rapid burning is controlled by the oxyhydrocarbons present in the charcoal. High-speed camera studies show that the gunpowder grains themselves burn comparatively slowly in a layer-wise fashion and suggest that the rapid propagation of the reaction from grain to grain is due to the emission of a hot spray of molten droplets of K salts. A.

541.127.4

6836. Equilibrium and the rate laws for forward and reverse reactions. C. A. HOLLINGSWORTH. Letter in *J. Chem. Phys.*, 20, 921–2 (May, 1952).

The ratio of rate laws having orders which are not simply related to the coefficients in the chemical equation, nevertheless leads to the equilibrium constant expression. The explanation is to be found in analysis of the restrictions imposed upon the rate laws in order that equilibrium conditions may be satisfied.

H. H. GREENWOOD

541.128

6837. Isotopic composition of oxygen in the catalytic decomposition of hydrogen peroxide. M. DOLE, D. P. RUDD, G. R. MUCHOW AND C. COMTE. *J. Chem. Phys.*, 20, 961–8 (June, 1952).

The isotopic composition of O liberated in the

catalytic decomposition of H_2O_2 using MnO_2 , Fe_2O_3 , colloidal Au, metallic Pt, and soluble catalase as catalysts was measured. All the catalysts except catalase produced a measurable fractionation of the O isotopes in the case of complete decomposition. A few rate experiments were also carried out, and the kinetics studied from the standpoint of isotope separation as a function of fraction of H_2O_2 decomposed. It is demonstrated that none of the liberated O comes from the substrate water or from the KMnO_4 when H_2O_2 is oxidized. Observed fractionation factors are somewhat smaller than the maximum values calculated on the basis of Bigeleisen's equations. A minimum in the O^{18} percentage of the evolved O in the case of the catalase experiments suggests that two mechanisms are operative for this type of catalysis. The initial enhancement of the O^{18} percentage of the evolved O over that in the peroxide remains unexplained. A.

541.128

6838. Catalysis of *cis-trans* isomerization by paramagnetic substances. H. MCCONNELL. Letter in *J. Chem. Phys.*, 20, 1043–4 (June, 1952).

It has been suggested that *cis-trans* isomerizations about carbon-carbon double bonds, when not catalysed, occur via a triplet state of the molecule. The catalytic action occurs in such a way, that a catalyst atom in doublet state interacts with the S and T states of the isomer, which results in two doublets and a quartet state. The energy gap between the doublets needs only to be small to make the lowest level far more probable.

A. J. TAYLOR

ELECTROCHEMISTRY 541.13

541.133

6839. A method for the study of ionic conductivities of certain salts at ordinary temperature. M. PERROT AND A. SATOR. *C.R. Acad. Sci. [Paris]* 234, 1883–5 (May 5, 1952) *In French*.

Experimental details are recorded of a method which enables the systematic study of the mechanism of ionic conductivity of numerous salts at ordinary temperature and *in vacuo*. Application is described for the case of PbCl_2 , whose conductivity is found to increase rapidly at first towards a limiting constant value, the three ions participating in the transport of the current. The condition of the electrodes (Pb, Au and Ag, which are used in turn) is described and illustrated by micro-photographs. H. H. HODGSON

541.133.1

6840. Migration of ^{35}S in NaCl in an applied electric field. M. CHEMLA. *C.R. Acad. Sci. [Paris]* 234, 2064–6 (May 19, 1952) *In French*.

S^{35} which is produced by fast neutrons in NaCl crystals, travels towards the anode, if an electrostatic potential is applied. This is carried out experimentally at temperatures between 650° and 775°C. The ratio of the diffusion coefficient to the mobility of the ions is measured and there is good agreement with relations derived theoretically, but Einstein's law cannot be applied.

A. J. TAYLOR

541.135

6841. Technical pH-measurements. F. LIENEWEG. *Siemens Z.*, 26, 188–95 (May, 1952) In German.

The various types of apparatus in use for pH-measurements in industrial operations are reviewed, together with a comprehensive list of the latter. Particular attention is paid to a comparison of the antimony and glass electrodes, while a section deals with the fundamental ideas and principles involved in electrometric pH-determinations. There are 17 illustrations.

H. H. HODGSON

541.135

6842. A study of iodide-iodine solutions with the e.m.f. centrifuge. D. A. MACINNES AND M. O. DAYHOFF. *J. Chem. Phys.*, 20, 1034–8 (June, 1952).

The potentials, observed with a galvanic cell with two iodide-iodine electrodes, at two different radii in a centrifugal field, were studied with solutions of KI and NaI, to which were added varying concentrations of I. Using a short extrapolation the transference numbers of NaI were obtained. The earlier results using KI were confirmed. These results, when interpreted with the aid of conductance measurements, indicated the presence of the ionic complex I_3^- . A small deviation from the theory has been found with the results for Na iodide-iodine solutions. The e.m.f. centrifuge used in earlier work was simplified, and a galvanic cell was utilized which avoids the collection of suspended particles on the electrodes.

A.

541.135

6843. Polarization in electrolytic solutions. I. Theory. H.-C. CHANG AND G. JAFFÉ. *J. Chem. Phys.*, 20, 1071–6 (July, 1952).

The theory of "Conductance in Polarizable Media" developed by one of the authors is modified in such a way as to be applicable to electrolytic solutions. This is achieved by the introduction of a new set of boundary conditions. In their original form they expressed the fact that the polarizing ions could not carry any current through the boundary. Now it is assumed that the discharge at the electrodes is a rate process of the first order, characterized by a rate constant ξ . The case of an applied a.c. voltage is treated. The expressions for the equivalent parallel conductance and capacitance of the polarization layer $1/R_p$ and C_p are derived by the same method, and to the same extent, as in the older theory. If ξ tends to zero, the previous results are obtained ("completely blocked electrode"). If ξ increases, the "polarization capacitance" and the "excess resistance" both decrease until they vanish for $\xi = \infty$ ("open electrode"). The dependence on frequency remains similar for all finite values of ξ . Subsequently the older theory is improved by a determination of the thickness of the polarization layer. Reduced values of $1/R_p$ and C_p can be represented as universal functions of one reduced variable, which is proportional to the frequency. The two universal functions are tabulated to some extent. Finally the theory is extended to the case where several groups of ions of different mobilities are present in the electrolyte.

A.

541.135

6844. Polarization in electrolytic solutions. II.

Measurements. G. JAFFÉ AND J. A. RIDER. *J. Chem. Phys.*, 20, 1077–87 (July, 1952).

The object of the present investigation was to supply material for testing the theory given in Pt I. Therefore the "polarization capacitance" and the "excess resistance" of electrolytic solutions were measured over wide ranges of frequency and concentration, and for different plate distances. Also the material of the electrodes was modified, and some temperature coefficients were measured. The method used is essentially a Jones bridge method, with suitable modifications. The range of frequencies was, as a rule, from 18 to 18 000 c/s; the molar concentrations varied from 10^{-4} to 10^{-2} g-eq./litre. In addition to solutions of KCl and $MgSO_4$, conductance water was investigated. Electrodes of Al, Ni, Au and Pt were used. The results are compared with those of the theory, by analysing completely several series of measurements referring to water and KCl solutions. A quantitative agreement can be realized, if (a) the effect of the solvent is taken into account, and if (b) it is admitted that there are, in "conductance water" ions of considerably (about 100 times) lower mobility than the ordinary electrolytic ions. With these assumptions the concentrations and the mobilities of the ions can be determined. Finally, the rate constants which are characteristic of the presented theory can be evaluated.

A.

541.135

6845. The time dependence of the potential in electrode reactions. W. R. BUSING AND W. KAUFMANN. *J. Chem. Phys.*, 20, 1129–43 (July, 1952).

Changes in the potential of an electrode with time during electrolysis at constant current are controlled by two factors: (1) the charging and discharging of the double layer capacitor (causing "capacitive" changes) and (2) alteration of the composition and other properties of the electrode and the adjacent solution (causing "non-capacitive" changes). Equations are derived for the capacitive changes in potential, assuming that the current-voltage relation across the electrode surface is given by Tafel's law. An experimental study was made of the potential accompanying the evolution of oxygen from 1N KOH at a platinum anode. When the current was held constant the potential increased slowly with time. When the current was interrupted the potential rapidly decreased, the decay being faster the higher the initial potential. The decay generally followed the above-mentioned equations for a capacitive change in potential, thus making it possible to evaluate effective Tafel constants of the electrode at various stages during electrolysis. These constants were found to depend very much on the time and on the current density, indicating that the electrode surface undergoes important changes. The behaviour of the potential on increasing or decreasing the current has also been studied. This too reflects changes in the electrode surface. Most of these variations can be understood if it is assumed that the electrode surface is non-uniform, the current being carried by relatively few active centres. The non-uniformity is similar to that encountered in ordinary catalysis, but is more complex since the same centres may not be active at all potentials. A simple graphical method of dealing with

ch a non-uniformity has been developed. It is based on the assumption that Tafel's law is valid for each microscopic element of the surface, and allows the Tafel constants to vary from one element to another. The electrode as a whole may then no longer obey Tafel's law. The concepts of poisoning and promotion, so important in catalysis, are readily incorporated and explain most of the observed results in a direct manner.

A.

541.135.5

46. The mechanism of the cathodic hydrogen evolution reaction. J. O'M. BOCKRIS AND E. C. POTTER. *Electrochem. Soc.*, **99**, 169-86 (April, 1952).

Some of the outstanding problems of concept and mechanism in the field of cathodic hydrogen evolution kinetics are discussed and clarified. A full derivation and correlation of kinetic equations which assume no mechanism reveals expressions for several parameters which take values specific to one or more mechanisms. The use of statistical methods of treatment of data proves indispensable in estimating the values of these parameters. A further method of ascertaining the mechanism of the hydrogen evolution reaction is to examine the kinetics of the individual reaction paths, so that the expected values of parameters common to all paths may be deduced. A number of mechanisms important in acid and alkaline solutions are thus treated, and are shown to be distinguishable experimentally. Using already published data, the actual conditions under which various reaction paths take place at Hg, Ag, Ni and smooth Pt cathodes are calculated. It is not only possible to compare these reduced data with observation, and thereby verify the occurrence of a particular reaction path, but also to demonstrate the impossibility of some mechanisms in specific cases. The recent advances which the foregoing methods have made possible are discussed in relation to data which have recently become available.

A.

541.135.5

47. Free energy of the double layers of two parallel plates in a 1-2 electrolyte. S. LEVINE AND J. SUDDABY. *Proc. Phys. Soc. [Lond.] A*, **65**, 405-18 (June, 1952).

By making use of the Poisson-Boltzmann equation an expression is obtained for the free energy of the electric double layers of two parallel plates immersed in a large volume of an electrolyte of the 1-2 valency type. Two cases arise depending on whether or not the divalent ion and the surface charge have the same sign. The formula for the free energy is expressed in terms of elliptic integrals. An approximate form for the free energy, which is more convenient for numerical computations, is also obtained. This is particularly suitable at large surface potentials and is derived for symmetrical electrolyte as well as for the asymmetrical ones. Numerical tables of the free energy as a function of plate separation are given and some applications are briefly indicated.

A.

541.136

48. Standardization mechanism of the iodine-iodide redox potential at platinum based on alternating current polarization. K. J. VETTER. *Z. phys. Chem.*, **199**, 285-99 (April, 1952) In German.

Polarization measurements are described for Pt

with a.c. between 100 c/s and 50 c/s at 25° for the iodide redox system with 1N H₂SO₄ addition (as foreign electrolyte excess). The frequency dependence and the phase displacement of the complex a.c. polarization resistance are in agreement with theory when certain reasonable assumptions are made. From the concentration dependence of the evaluated exchange current density, it follows that the reaction $I + e^- \rightleftharpoons I'$ is a potential determining step, on which the rapid dissociation reactions: $I'_3 \rightleftharpoons I_2 + I'$ and $I_2 \rightleftharpoons 2I$ are imposed. The diffusion polarization resistance is proportional to the sum of the quotients of diffusion coefficient by concentration.

H. H. HODGSON

541.136

6849. Direct and alternating current resistance of the diffusion polarization for locally variable exchange current density at the electrode. K. J. VETTER. *Z. phys. Chem.*, **199**, 300-13 (April, 1952) In German.

The d.c. diffusion resistance when there are separate centres of the exchange current density at the electrodes, and for the presence of an adhering liquid layer, is determined by means of conductivity measurements for corresponding models, since both problems are mathematically similar; so long as the radii of the active and inactive surfaces are small with respect to the adhering layer density, the diffusion resistance has practically the value for constant exchange current density. The a.c. diffusion resistance depends on the penetration depth of the concentration wave; when this is small with respect to the average radius of the active surfaces, a reduced electrode surface is implied, but when large with respect to the radii of the inactive surfaces, there is practically no influence due to the inconstancy of the exchange current density; for intermediate values an approximation has been calculated. The behaviour of the frequency dependence of the Ohm and capacity factors is discussed and found to be in agreement with the experimental curves. The average magnitudes of the radii of the active and inactive surfaces are determined from the frequency values at the breaks of these curves.

H. H. HODGSON

541.138

6850. Semi-permeability of the copper ferrocyanide membrane. R. LANDSBERG. *Z. phys. Chem.*, **199**, 266-79 (Feb., 1952) In German.

Potential determinations have been carried out with copper ferrocyanide membranes in cellophane. By using the same mono-mono-valent or mono-divalent electrolytes on the two sides of the membrane at a constant concentration ratio, but different absolute concentrations, a "concentration effect" was observed, the membrane potential decreasing with increasing absolute concentration. The effect was greater for K⁺ than for Na⁺. When a di-mono- or di-divalent electrolyte was used on one side and a mono-mono- or mono-divalent on the other side, the side with the divalent cation became strongly positively charged. Calculation of the membrane potential in this case, by the theory of Meyer and Sievers and of Teorell gives values about 65 mV smaller than those observed. This deviation is explained as being principally due to a sieve effect.

A. J. MEE

541.138

6851. Potentials during the formation of membranes by precipitation. II. R. LANDSBERG. *Z. phys. Chem.*, **199**, 280-2 (Feb., 1952) *In German*.

Continuation of previous work [Abstr. 608 (1952)]. The time dependence of the electrical potential is studied when potassium ferrocyanide reacts with a copper salt to form a membrane by precipitation. With CuSO_4 a higher steady potential is found after a shorter time than with CuCl_2 . This is discussed.

P. T. LANDSBERG

PHOTOCHEMISTRY . RADIATION CHEMISTRY 541.14/15

541.14

6852. The photochemical decomposition of methylamine. J. S. WATSON AND B. DEB. DARWENT. Letter in *J. Chem. Phys.*, **20**, 1041-2 (June, 1952).

This reaction yields hydrogen, ammonia and a heavy liquid, which is found to consist largely of $(\text{CH}_3\text{N})_2\text{CH}_2$. In order to investigate the mechanism, the reaction is also carried out with CH_3ND_2 . It is concluded that both radicals CH_3NH and CH_2NH_2 are formed, and that the recombination of these radicals yields $\text{CH}_3\text{NH}\cdot\text{CH}_2\text{NH}_2$, which would decompose and polymerize into the substance found.

A. J. TAYLOR

541.14 : 534.23

The chemical effects of ultrasonics. See Abstr. 6347

541.15

6853. Energy absorption by externally irradiated liquids. I. S. L. WHITCHER. *Nucleonics*, **10**, 47-51 (April, 1952).

In order to determine the relative sensitivity of a given chemical reaction, produced in a solution by high-energy radiation such as X- or γ -rays, it is necessary to determine the amount of energy absorbed from the irradiating beam. This must be accomplished by means of ionization chamber measurements. The paper deals in a general manner with the problem of converting the ion chamber measurements into values for the energy absorption in a given medium.

L. R. SHEPHERD

541.15

6854. Radiation-induced decomposition of certain organic molecules in solution. M. G. ALDER AND H. EYRING. *Nucleonics*, **10**, 54-7 (April, 1952).

The decomposition of a solute in dilute aqueous solution containing oxygen is examined on the basis of a mechanism involving the action of H , OH , HO_2 radicals formed in the water by the action of the radiation. An expression is derived for the ionic yield (moles of solute dissociated per r) in terms of initial solute and oxygen concentration. Satisfactory agreement with experimental results on aqueous solutions of glutathione, fluorescein and certain vitamins has been observed. An average value of 3.6 water molecules dissociated per 100 eV of energy absorbed from X-rays or cathode-rays has been deduced.

L. R. SHEPHERD

541.15

6855. Oxidation of aqueous ferrous ammonium sulfate solutions by betatron radiation. R. W. HUMMEL

AND J. W. T. SPINKS. Letter in *J. Chem. Phys.*, **20**, 1056 (June, 1952).

Measured G -values for ferrous ammonium sulphate in 0.8 sulphuric acid are 15.8 for 24.5-MeV (peak) X-rays (betatron) and 16.8 for Ra γ -rays, the mean of tabulated values being 17.0 with a standard deviation of 0.9. Such solutions may therefore be used for X-ray dosimetry up to 24-MeV.

C. B. ALLSOP

541.15

6856. Effect of ionizing radiation on protein denaturation. H. FRICKE. Letter in *Nature [Lond.]* **169**, 956-6 (June 7, 1952).

The denaturation of heterogeneous protein material is analysed in terms of the Arrhenius frequency factor and energy of inactivation. Large increases in both these quantities indicate important structural changes.

F. T. FARMER

DISPERSIONS . COLLOIDS . ADSORPTION 541.18

541.18

6857. Carbon-oxygen exchange in chemisorbed carbon monoxide. R. P. EISENBERG AND A. N. WEBB. Letter in *J. Chem. Phys.*, **20**, 1048-9 (June, 1952).

A mixture of C^{13}O and CO^{18} was chemisorbed on iron and then desorbed. The amount of $\text{C}^{13}\text{O}^{18}$ in the desorbed gas exceeded that expected from normal abundance ratios, showing that an intramolecular oxygen exchange occurs in the adsorbed film. Alternative mechanisms are proposed.

S. J. GREGG

CHEMICAL STRUCTURE 541.2/6

541.2

6858. Investigation of the mutual influence of unconnected multiple bonds by Raman spectra. A. KH. KHALILOV AND P. P. SHORYGIN. *Dokl. Akad. Nauk SSSR*, **78**, 1177-80 (No. 6, 1951) *In Russian*.

541.6

6859. A linear polymer as a mixture of rotational isomers. M. V. VOLKENSHTEIN. *Dokl. Akad. Nauk SSSR*, **78**, 879-82 (No. 5, 1951) *In Russian*.

541.64 : 541.64

6860. Morphology of crystallizing polymers. A. KELLER. *Nature [Lond.]* **169**, 913-14 (May 31, 1952).

The process of crystallization from the melt of polyethylene terephthalate has been studied at different temperatures. The polarizing microscope and X-ray diffraction show that crystalline spherulites form and grow in an amorphous mass. The spherulites have a different appearance according to the temperature of formation. At 220°C the cross seen when they are viewed between crossed nicols appears as zig-zag line and this is explained as follows. The molecules first form fibrils which are flat and helical coiled ribbons; the fibrils aggregate and form spherulites. The helical angle depends on the temperature. Electron micrographs of solvent-cast films of the same substance show formations of fibre bundles which confirm the above explanation of the optical appearance. It is suggested that the phenomenon may be more general.

and not necessarily limited to long-chain compounds.

J. IBALL

541.653

61. [Magnetic] rotativities of gaseous and liquid ammonia. R. DE MALLEMANN, F. SUHNER AND MALEVERGNE. *C.R. Acad. Sci. [Paris]* **234**, 629–31 (May 12, 1952) *In French*.

Values of the density, refractive index, specific magnetic rotation and rotativity of liquid NH_3 at mps. between -34° and -77°C are tabulated. The specific rotation of gaseous NH_3 measured at 18°C and about 4 atmospheres pressure is appreciably less than that of the liquid whereas the refractivity is the same in each case.

G. I. W. LLEWELYN

541.67

62. The anomalous susceptibilities of three-membered ring compounds. J. R. LACHER, J. W. COLLOCK AND J. D. PARK. Letter in *J. Chem. Phys.*, **20**, 1047–8 (June, 1952).

The following molar diamagnetic susceptibilities ($\times 10^{-6}$) are recorded: cyclopropane 39.9, ethylene oxide 30.7, propylene oxide 42.5. These abnormally high values are attributed to anisotropy caused by precession of electrons about the plane of the ring.

G. I. W. LLEWELYN

LABORATORY APPARATUS 542.1/7

542.7

63. Purification of rare gases by activated uranium. H. H. DIEKE AND H. M. CROSSWHITE. Letter in *Opt. Soc. Amer.*, **42**, 433 (June, 1952).
Activated uranium, obtained by heating UH_3 to

about 400°C and thus driving out the hydrogen, reacts with practically every gas except the rare gases. Its use in rare gas discharge tubes is briefly referred to. See also Abstr. 4216 (1952).

S. WEINTROUB

CHEMICAL ANALYSIS 543/545

545.3

6864. The use of ionization probability curves for the analysis of CO and N_2 mixtures. W. M. HICKAM AND R. E. FOX. Letter in *J. Chem. Phys.*, **20**, 1055 (June, 1952).

Curves of ionization probability against electron energy for a monochromatic beam of electrons are linear for pure CO and N_2 . For mixtures the curve shows two linear portions, with an abrupt change of slope at the ionization potential of N_2 ; a quantitative analysis can be made from the slopes.

A. G. GAYDON

545.822

6865. Some applications of photomultiplier tubes to spectrographic analysis. J. K. BRODY. *J. Opt. Soc. Amer.*, **42**, 408–15 (June, 1952).

A mounting for two photomultiplier tubes for the Baird spectrograph is described. Leeds and Northrup experimental preamplifiers and ratio recorder are used in conjunction with the photomultipliers. The 60-cycle a.c. signal system is described. The equipment has been used in three analytical problems: the determination of Li in the flame; U isotopic determinations using the hollow cathode and the spark, and the Cu spark determination of Sc. The precision of the U isotopic determination is discussed.

A.

CRYSTALLOGRAPHY 548

548.0 : 534.321.9 : 539.9

Effect of ultrasound on stress distribution in a monocrystal of a solid solution of the bromide and iodide of thallium. See Abstr. 6801

548.0 : 541.135

6866. The influence of electrolytes on the mechanical properties of certain metal single crystals. E. N. DA C. ANDRADE AND R. F. Y. RANDALL. *Proc. Phys. Soc. [Lond.] B*, **65**, 445–54 (June, 1952).

The contact of electrolytes has a marked effect on the mechanical behaviour of single crystals of Cd and Zn which have been exposed to the air. This is due to the disruption, or formation, of a thin surface film, probably of oxide or hydroxide. If ordinary single crystal Cd wires are loaded so as to flow very slowly, the contact of solutions containing free Cd ions increases the rate of flow; a similar effect exists in the case of Zn treated with solutions of Zn salts. If the surface of the wire is cleaned by preliminary thermal evaporation there is no such effect, establishing that it is due to a surface film normally present. Solutions of Cd or Zn nitrate stop the flow and raise the critical shear stress appreciably, which is attributed to the formation of a surface film, probably of hydroxide. With the Cd nitrate there is a temporary increase of flow before the cessation, which is attributed to the

Cd ion, for there is no such effect with the Zn nitrate. With polycrystalline wires there is no electrolyte effect. The work described supports the view that a thin oxide or hydroxide film increases the mechanical resistance of single crystal wires, and that with Cd and Zn wires such a film is normally present.

A.

548.12

6867. The symmetry of certain types of crystalline groups. M. MATSCHINSKI. *Experientia*, **8**, 165–71 (No. 5, 1952) *In French*.

An investigation was made of the kinds of symmetry of crystalline groups (crystalloids) with infinite symmetry axes. The experiments give symmetry elements with which a total of 89 forms can be constructed correspondingly. They belong to 10 classes of symmetry. The fact that the holoedric and the hemiedric classes correspond to one another makes it possible to order these 10 classes into 4 systems (not counting the fifth, an asymmetric system).

A.

548.52

6868. Growth spirals originating from screw dislocations on gold crystals. S. AMELINCKX. *Phil. Mag.*, **43**, 562–7 (May, 1952).

The present paper gives a more detailed account of the observation of growth spirals on (111) faces of

gold crystals, obtained by precipitation [see Abstr. 3099 (1952)]. The observations prove that Frank's theory also holds for metal crystals; moreover, they constitute the first visual proof for the presence in metal crystals of dislocations in general, and screw dislocations in particular. They further show that the Burgers vector of dislocations in metals is not necessarily limited to one unit of a few simple lattice displacements, as is generally assumed. The shape of the growth spirals is briefly discussed. A.

548.52

6869. Holes in crystals. F. H. HORN, E. F. FULLAM AND J. S. KASPER. Letter in *Nature* [Lond.] **169**, 927-8 (May 31, 1952).

It was shown, by etching with HCl, that almost every crystal in a preparation of AlB_2 had a hole in it at the centre of a growth spiral. A. R. STOKES

548.52

6870. The growing of single crystals of magnetite. J. SMILTENS. *J. Chem. Phys.*, **20**, 990-4 (June, 1952).

Large, single crystals of magnetite, 1 cm in dia. and up to 4.3 cm long, of high purity and perfection were grown from the melt. The density of 20° is 5.185, i.e. 99.58% of the X-ray density. The composition corresponds to stoichiometric Fe_3O_4 within analytical error. Phase diagram considerations, growing procedure, methods of chemical analysis and composition data are discussed. A.

548.538

6871. New observations of crystal overgrowth on silicon carbide. A. R. VERMA. *Proc. Phys. Soc.* [Lond.] **B**, **65**, 525-8 (July, 1952).

On the faces of some silicon carbide crystals showing "growth spirals" superimposed oriented overgrowths can sometimes be observed. These oriented overgrowths which took place during the process of manufacture consist of stepped triangular pyramids with craters at their peaks, the pyramids having heights up to a few wavelengths of light and built sometimes on platforms of similar heights. These conclusions have been arrived at by the application of the techniques of multiple-beam interferometry and light-profile microscopy. In addition to the pyramids some trigonal, hexagonal and their compound figures have also been observed, which by the application of multiple-beam interference fringes are shown to be molecular oriented layers. These oriented molecular layers, the existence of which is revealed from the observation of the above overgrowths on silicon carbide crystals, may be silica deposit or possibly the growth of silicon carbide on itself. A.

MOLECULAR AND X-RAY CRYSTALLOGRAPHY 548.7

548.7

6872. An experimental search for self-trapped electrons in the alkali halides. W. H. DUEBIG. Letter in *Phys. Rev.*, **86**, 565 (May 15, 1952).

Experiments on NaCl, KCl and KBr at 5°K show that electrons diffuse freely through their crystal lattices since no indication of self-trapping is given by infra-red absorption spectra. G. F. J. GARLICK

548.7
6873. On the limiting vibrational frequencies of an ionic lattice. M. BLACKMAN. *Proc. Phys. Soc.* [Lond.] **A**, **65**, 394-404 (June, 1952).

The vibrational frequencies of an orthorhombic ionic lattice, of the thallium fluoride type, have been worked out in detail for wavelengths long compared with the crystal spacing though short in relation to the crystal size. It is shown that these frequencies are not unique but depend in general on the direction of the wave in the crystal—on contrast to what happens in cubic crystals. The effect of this behaviour on the vibrational spectrum is discussed briefly. A.

548.7 : 535.375.3

6874. A new tool for the study of crystalline spectra. G. L. HIEBERT AND D. F. HORNIG. Letter in *J. Chem. Phys.*, **20**, 918-19 (May, 1952).

Isotopic dilution as a means of separating the effects of intermolecular forces and intermolecular coupling is illustrated on the spectrum of a dilute solution of HCl in crystalline DCl at 68°K . C. TURNER

548.73/.74 : 539.26/.21

X-ray and electron investigation of materials. See Abstr. 6793-7

548.732 : 539.33

6875. Approximate elastic spectrum of β -brass from X-ray scattering. H. COLE AND B. E. WARREN. *J. Appl. Phys.*, **23**, 335-40 (March, 1952).

The temperature diffuse scattering of X-rays from a single crystal of β -brass was measured at room temperature using a Geiger counter spectrometer and crystal monochromated Cu $K\alpha$ radiation. Measurements were made throughout a large region in reciprocal space, with special attention given to the hko plane. The results were in excellent qualitative agreement with the theory developed by Laval and James in which temperature vibrations are expressed in terms of elastic waves. From the measurements dispersion curves are obtained giving the velocity and frequency of the elastic waves, in the [100], [110] and [111] directions, as a function of their wavelengths. An approximate frequency spectrum is then calculated on the basis of these dispersion curves. The velocities at infinite wavelength are shown to agree with those given by elastic theory using the static elastic constants. A.

548.733

6876. A Weissenberg X-ray diffraction camera. C. A. BEEVERS. *J. Sci. Instrum.*, **29**, 230-2 (July, 1952).

The special features are its simple and substantial construction, and the large diameter of film-holder and consequent large size of the photograph. The distance from focal spot to crystal is 100 mm and thus exposure times are particularly short. These advantages are gained by the sacrifice of the equi-inclination feature provided in the majority of Weissenberg cameras. A.

548.734.1

6877. X-ray absorption corrections for single crystals. H. T. EVANS, JR. *J. Appl. Phys.*, **23**, 663-4 (June, 1952).

It is shown that exact expressions may be derived for the absorption factor for the intensity of Bragg reflection by a small euhedral crystal completely

ed in a parallel X-ray beam. The expression is a sum of terms evaluated for subdivisions of the crystal determined according to discontinuities in boundary conditions imposed by the distribution of phases between the plane faces of the crystal. For a lamellar crystal of constant cross-section, general expressions are derived for 5 general types of subdivisions in terms of the linear absorption coefficient and certain linear dimensions. Other expressions are also given for other types of subdivisions which arise in certain cases. The application of the method, including corrections for secondary extinction, is illustrated by calculations on tetragonal BaTiO_3 . A.

548.735

8. The diffraction of X-rays by distorted-crystal aggregates. IV. Diffraction by a crystal with an axial screw dislocation. A. J. C. WILSON. *Acta Cryst.*, **5**, 19–22 (No. 3, 1952).

For Pt III, see Abstr. 3114 (1952). In the reciprocal-space representation, the regions of high intensity are disks perpendicular to the dislocation axis. The variation of amplitude or reflection across a disk can be represented either as an integral or as a finite series involving Bessel functions. Expressions for the integral breadths of lines on powder photographs are obtained in closed form. A.

548.735

9. A simple interpretation of the artificial temperature factor used in structure analysis. E. F. CATAUT. Note in *Acta Cryst.*, **5**, 387–8 (No. 3, 1952) (French).

The use of an artificial temperature factor $(-A \cdot \sin^2 \theta)$ is equivalent to replacing the electron density at every point by its "second mean" through a tube of edge $\lambda/2\sqrt{A/\pi}$. A. R. STOKES

548.735

10. Thermal scattering of X-rays by single crystals of α -Fe and dynamics of the body-centred cubic lattice. C. CURIEN. Note in *Acta Cryst.*, **5**, 393 (No. 3, 1952) (French).

Frequency spectra for the thermal vibrations in α -Fe are worked out from measurements of the thermal diffuse scattering of X-rays and compared with the calculated values. From this comparison estimates are obtained of the radial attractive forces between the first, second and third nearest neighbours.

J. THEWLIS

548.735 : 518.5

11. A simple mechanical structure-factor computing aid. V. VAND. Note in *Acta Cryst.*, **5**, 390–1 (No. 3, 1952).

The machine gives $C_n = \cos 2\pi(nu + m)$ simultaneously for each integer n from 0 to 10 by means of gear trains and calibrated dials. A. R. STOKES

548.735.7

12. Influence of the apparatus function on crystal-size determinations with Geiger counter spectrometers. F. R. L. SCHOENING, J. N. VAN NIEKERK AND A. W. HAUL. *Proc. Phys. Soc. [Lond.] B*, **65**, 33–35 (July, 1952).

A brief survey of the various methods used for determining crystallite sizes from X-ray diffraction line broadening is given. It is shown that the diffrac-

tion profiles determined experimentally with a Geiger counter X-ray spectrometer can be represented by functions of the type $y = c/(1 + k^2x^2)^2$. Using these functions a correction curve for instrumental influence on line breadth measurements is derived by solving

the integral equation $B(x) = \int_{-\infty}^{+\infty} b(v)\beta(x-v)dv$ by

means of the Fourier transform method. The apparatus function $b(x)$ is determined by using a standard substance. Experiments are described which illustrate the effect of sample preparation, absorption, etc., on measurements of line breadth. A.

548.736.1

6883. A correction and note on the relation of the β -uranium and σ -phase structures. C. W. TUCKER, JR. Note in *Acta Cryst.*, **5**, 389 (No. 3, 1952).

See Abstr. 9144 (1951). The correction concerns a reference to Shoemaker and Bergman [*J. Amer. Chem. Soc.*, **72**, 5793 (1950)]. A. R. STOKES

548.736.1

6884. A supplementary note on the crystal structure of β -uranium. C. W. TUCKER, JR. Note in *Acta Cryst.*, **5**, 395–6 (No. 3, 1952).

A reply to a criticism made by Shoemaker regarding the puckering of the layers in β -U and to a suggestion by Thewlis that the detailed structure of β -U differs from that of the U-Cr alloy on which Tucker's original structure was based. From estimated X-ray intensities it is shown that the layers are not flat; and the differences between the U-Cr alloy and β -U are provisionally ascribed to preferred orientation.

J. THEWLIS

548.736.3

6885. The crystal structure of B_2O_3 . S. V. BERGER. Note in *Acta Cryst.*, **5**, 389 (No. 3, 1952).

Powder photographs give hexagonal axes, $a = 4.325\text{\AA}$, $c = 8.317\text{\AA}$, space-group $C_{3i}(C_{3v})$. Atomic positions and separations are given. A. R. STOKES

548.736.3

6886. X-ray and neutron diffraction studies of the MBe_{13} intermetallic compounds. W. C. KOEHLER, J. SINGER AND A. S. COFFINBERRY. Note in *Acta Cryst.*, **5**, 394 (No. 3, 1952).

X-ray and neutron diffraction measurements indicate that the cubic compounds which occur in alloys having a high Be content are face-centred, have the composition MBe_{13} and are isomorphous with NaZn_{13} .

J. THEWLIS

548.736.3

6887. Transitions in the chromium-manganese and nickel-vanadium sigma phases. W. B. PEARSON. Letter in *Nature [Lond.]* **169**, 934 (May 31, 1952).

The main X-ray reflections given out by the high-temperature phase are the same as those observed at room temperature. The transitions may be of the order-disorder type. H. P. MYERS

548.736.3

6888. The structure of the Cu-Ge system. K. SCHUBERT AND G. BRANDAUER. Note in *Naturwissenschaften*, **39**, 208–9 (No. 9, 1952) In German.

A brief report of an X-ray analysis of the Cu-Ge alloy system. P. T. LANDSBERG

548.736.3

6889. Theory of order-disorder changes in the alloys Au-Cu₃. G. FOURNET. *C.R. Acad. Sci. [Paris]* **234**, 2049-51 (May 19, 1952) *In French*.

The note extends the methods previously applied to Cu-Zn alloys [Abstr. 3909 (1951)], and examines the cases of both long- and short-range order. Calculated and experimental quantities are compared. The theory also enables the reciprocal lattice to be determined, and the form of the lines of iso-intensity for the (100) plane of the lattice agrees well with experiment. In general, the method enables short-range phenomena to be predicted from information on long-range order.

A. J. KENNEDY

548.736.3

6890. Borides of some transition elements. B. POST AND F. W. GLASER. Letter in *J. Chem. Phys.*, **20**, 1050-1 (June, 1952).

The crystal structures of borides of W, Ti and Zr have been investigated by means of an X-ray diffraction study of powdered samples. G. I. W. LLEWELYN

548.736.4

6891. Crystal structure of sodium hydroxide with 4 molecules of water. P. HEMILY. *C.R. Acad. Sci. [Paris]* **234**, 2085-7 (May 19, 1952) *In French*.

The unit cell is monoclinic, with $a = 15.47$, $b = 4.04$, $c = 9.44\text{\AA}$, $\beta = 117^\circ 15'$, containing 4 mols NaOH.4H₂O. Atomic coordinates are given; all atoms lie in planes $y = 0$, $y = \frac{1}{2}$.

A. R. STOKES

548.736.4

6892. The crystal structure of KSbF₆. A. BYSTRÖM, S. BÄCKLUND AND K.-A. WILHELM. *Ark. Kemi*, **4**, 175-83 (Paper No. 8, 1952).

Orthorhombic, $Pmmn$, $a = 16.30 \pm 2$, $b = 11.57 \pm 2$, $c = 4.546 \pm 1\text{\AA}$. A complete structure determination is given, with good agreement between observed and calculated F 's. Preliminary data for NaSbF₆ are: monoclinic, probably $P2_1/c$, $a = 8.1$, $b = 5.5$, $c = 8.5\text{\AA}$, $\beta = 96^\circ$.

A. J. C. WILSON

548.736.5

6893. Laue photographs of crystals of synthetic corundum. E. N. BELOVA AND N. YU. IKORNIKOVA. *Dokl. Akad. Nauk SSSR*, **81**, 829-32 (No. 5, 1951) *In Russian*.

Polished slices of synthetic corundum were examined in polarized light and by X-ray Laue photographs. Regions observed in the mosaic were found to be single crystals and these individuals were angularly displaced a few degrees from each other, but were roughly parallel, thus giving Laue photographs with split spots.

A. L. MACKAY

548.736.5

6894. The structure of calcium iron oxide, CaO.Fe₂O₃. A. BURDESE. *Ric. Sci.*, **22**, 259-64 (Feb., 1952) *In Italian*.

Orthorhombic, $a = 9.16$, $b = 10.60$, $c = 3.01$ [$\text{\AA}$ or kX?], measured density 4.70-4.85 (sintered), 4.87 (fused), calculated density 4.90 for $Z = 4$. It is stated that the oxygen atoms are almost in hexagonal close-packing, and that the structure has some analogy with that of goethite, but no details are given.

A. J. C. WILSON

548.736.5

6895. The crystal structures of thiocyanates. IV. X-ray investigation of the crystal structures of Hg(SCN)₂.ASCN (where A = K, NH₄). G. S. ZHDANOV AND V. V. SANADZE. *Zh. Fiz. Khim.*, **26**, 469-78 (No. 4, 1952) *In Russian*.

The compounds Hg(SCN)₂.KSCN and Hg(SCN)₂.NH₄SCN were found to crystallize isomorphously with the space group $P2_1/m$. For the K compound, $a = 11.081$, $b = 4.07$, $c = 10.915\text{\AA}$, $\beta = 114^\circ 45'$, $Z = 2$, ρ obs. = 3.00 and ρ calc. = 3.05. For the ammonium isomorph, $a = 11.185$, $b = 4.08$, $c = 10.935\text{\AA}$, $\beta = 114^\circ 55'$, $Z = 2$ and ρ obs. = ρ calc. = 2.86. The parameters of all atoms were found. Interatomic distances show the presence of molecular groups Hg(SCN)₂ with covalent bonds and with the expected bond angles. The structure may be considered that of a double salt rather than that of a complex compound.

A. L. MACKAY

548.736.5

6896. The crystal structures of thiocyanates. V. The crystal structures of the halogen thiocyanates of mercury. Z. V. ZVONKOVA AND G. S. ZHDANOV. *Zh. Fiz. Khim.*, **26**, 586-91 (No. 4, 1952) *In Russian*.

HgClSCN was found to have the space group $P2_12_12_1$ and dimensions $a = 10.14$, $b = 4.22$ and $c = 10.38$ kX and HgBrSCN to have the space group $P2_1/m$ with dimensions $a = 6.23$, $b = 4.27$, $c = 8.72$ kX and $\beta = 91^\circ 20'$. Observed densities were 4.28 and 4.74 giving $Z = 4$ and 2 respectively. The x and z parameters were found to be: Cl compound, Hg(0.155, 0.359); Cl(0.134, 0.579); S(0.199, 0.141); N(0.474, 0.141). Br compound, Hg(0.045, 0.202); Br(0.737, 0.027); S(0.351, 0.364). The bond distances Hg-Cl, Hg-Br and Hg-S were 2.25, 2.44 and 2.32 kX respectively.

A. L. MACKAY

548.736.5

6897. X-ray investigation of Co(NH₃)₆PbCl₆ and Co(NH₃)₆BiCl₆. M. ATOJI AND T. WATANABE. Letter in *J. Chem. Phys.*, **20**, 1045-6 (June, 1952).

From powder photographs it is deduced that the Bi complex is isomorphous with the Tl complex, and is cubic, with $a = 11.54\text{\AA}$, space-group $Pa\bar{3}$. Atomic coordinates are given. The Pb complex has $a = 11.52\text{\AA}$, space-group $Pa\bar{3}$ except for faint additional lines. Colour and magnetic properties are discussed.

A. R. STOKES

548.736.6

6898. Crystal structure of ilvaite [lievrite]. N. V. BELOV AND V. I. MOKEEVA. *Dokl. Akad. Nauk SSSR*, **81**, 825-7 (No. 5, 1951) *In Russian*.

Two independent determinations of the structure of ilvaite [CaFe₂⁺+Fe⁺⁺⁺Si₂O₆(OH)] are found to disagree completely [Y. Takeuchi, *X-rays* (Osaka) **5**, 8 (1948), and N. V. Belov and V. I. Mokeeva, Abstr. 6205 (1952)]. The former is severely criticized on account of the interatomic distances entailed.

A. L. MACKAY

548.736.6

6899. Studies on the sharp extra reflections from phloroglucine dihydrate crystal. I. Effect of orientation of the crystal with respect to the X-ray beam. M. N. DATTA. *Indian J. Phys.*, **25**, 581-4 (Dec., 1951).

The sharp extra reflections from phloroglucine

dihydrate have been studied for various orientations of the crystal with respect to the incident X-ray beam. It has been found that the variations of the intensities of the spots are extremely slow and continuous as the crystal rotates from one Bragg position to another with the same values of h and k indices. The intensities are maxima at the Bragg positions and pass through minimum values at intermediate positions. The extra spots with indices $h = 0$ or $k = 0$ are not absent when the incident beam is inclined to the c -axis.

A.

548.737

6900. The tetrahedral configuration of paramagnetic complexes of nickel with coordination number 4. D. H. CURTISS, F. K. C. LYLE AND E. C. LINGAFELTER. Note in *Acta Cryst.*, **5**, 388 (No. 3, 1952).

It is shown, by comparison with the isomorphous Zn salt, that Ni disalicylaldehyde probably has the tetrahedral configuration.

A. R. STOKES

548.737

6901. The crystal structures of the tri- β -chlorvinylstibines. YU. T. STRUCHKOV, A. I. KITAIGORODSKIĬ AND T. L. KHOTSYANOVA. *Zh. Fiz. Khim.*, **26**, 530–7 (No. 4, 1952) In Russian.

Two isomers of $(ClCH = CH)_3SbCl_2$ were examined crystallographically. I, the trans-trans-trans isomer had m.p.t. $93-94^\circ$ and $d_{20} = 1.9289$. Crystals were monoclinic, $C2/c$, with $a = 20.82$, $b = 6.99$, $c = 17.23\text{\AA}$, $\beta = 101^\circ 50'$, $Z = 8$. Errors in dimensions are estimated at $\pm 0.5\%$. From $h0l$ Patterson and Fourier projections (5 refinements) the x and z coordinates of Sb and Cl atoms were found to ± 0.002 of the cell edges. The reliability index for the projection was 0.37 . II, the cis-cis-cis isomer had m.p.t. $61-62^\circ$ and $d_{20} = 1.9148$. Crystals were orthorhombic, Pbc , with $a = 15.96$, $b = 6.98$, $c = 21.92\text{\AA}$ and $Z = 8$. Coordinates of Sb and Cl atoms in the $h0l$ projection were found. Resemblances exist between the two structures.

A. L. MACKAY

548.737

6902. A critical examination of some structure models of crystalline proteins. K. DORNBERGER-SCHIFF. *Z. phys. Chem.*, **199**, 350–69 (April, 1952) In German.

Models of complex structures give positions for part of the atoms (perhaps those in an amino-acid skeleton) but leave the rest (perhaps in side chains) indefinite. A test is proposed, based on the ratio (average intensity of reflections to which the atoms in definite positions in the model contribute)/(average intensity of reflections to which atoms in definite positions do not contribute). If the model is wrong, this ratio will be near unity, whereas if it approaches correctness the ratio will be larger than unity, and approach a value that can be calculated from the nature of the model. The test is applied to a model of horse metmyoglobin with favourable results, and to models of some other proteins with unfavourable results. The height of peaks in Patterson projections is discussed from a similar point of view.

A. J. C. WILSON

548.737

6903. On the two hydrates of mercerized cellulose. C. LEGRAND. *C.R. Acad. Sci. [Paris]* **234**, 2207–9 (May 26, 1952) In French.

The cell dimensions of hydrated mercerized cellulose cannot be used to determine the proportions of water and cellulose, since some dehydration can take place without change in lattice parameters.

A. R. STOKES

548.737

6904. Structure of the synthetic polypeptide poly- γ -L-glutamate. H. L. YAKEL, JR, L. PAULING AND R. B. COREY. Letter in *Nature [Lond.]* **169**, 920 (May 31, 1952).

Further X-ray diffraction analysis of oriented fibres of the above material confirms the earlier suggestion that it is composed of the α -helix with 18 residues in 5 turns. In addition, the results indicate that the β -carbon atoms are in position 2 rather than position 1. The dimensions of the hexagonal unit cell are $a = 11.58\text{\AA}$, $c = 26.33\text{\AA}$.

J. IBALL

548.737

6905. On the vector map of crystalline horsehemoglobin. D. WRINCH. Letter in *J. Chem. Phys.*, **20**, 1051 (June, 1952).

Certain features of the vector map are attributed to the large amount of water present in the crystal structure.

A. R. STOKES

548.737

6906. Orientation of the polypeptide chains in crystals of acid insulin sulphate. B. W. LOW. *Nature [Lond.]* **169**, 955–6 (June 7, 1952).

The Patterson projection along the a -axis and the three-dimensional Patterson synthesis both indicate that rod-shaped regions of high electron density run parallel to the a -axis. This is discussed in relation to work of Sanger [*Nature (Lond.)* **162**, 491 (1949)] and Ambrose and Elliott [Abstr. 7730 (1951)].

A. R. STOKES

548.74

6907. Electron diffraction in some cubical crystals. S. K. MAJUMDAR. *Indian J. Phys.*, **25**, 533–8 (Nov., 1951).

The spacings of a number of cubical crystals, obtained by metal evaporation in high vacuum, have been determined in the electron microscope from the diffraction photographs. Except for AgBr, the values tally with those obtained from X-ray diffraction measurements. The diffraction photographs obtained are very much sharper than similar pictures obtained with metal foils by previous workers.

A.

548.74

6908. Electron diffraction in sodium and potassium chloride crystals. S. K. MAJUMDAR. *Indian J. Phys.*, **25**, 594–8 (Dec., 1951).

The electron diffraction patterns of NaCl and KCl crystals have been investigated with an electron microscope. The mean values of the spacings, as calculated from the observed rings, come out to be $5.529\text{\AA}$ for NaCl and $6.22\text{\AA}$ KCl, the standard values being $5.63\text{\AA}$ and $6.28\text{\AA}$ respectively.

A.

548.74
6909. Electron diffraction evidence for the existence and fine structure of a cryptomelane modification of manganese dioxide prepared in the absence of potassium. G. BUTLER AND H. R. THIRSK. Note in *Acta Cryst.*, 5, 288-9 (March, 1952).

Examination by the electron microscope and by electron diffraction show that crystals of MnO_2 prepared in the presence of K and (NH_4) respectively, differ in habit and unit cell size. It is suggested that the latter material has the same structure as crypto-

melane and that the (NH_4) ion may replace the K ion in cryptomelane. The electron diffraction spots show crystal-shape effects. J. THEWLIS

548.74
6910. The structure of ammonium chloride by neutron diffraction. G. H. GOLDSCHMIDT AND D. G. HURST. Letter in *Phys. Rev.*, 86, 797 (June 1, 1952).

Recent measurements show that the authors' previous measurements on the room-temperature phase were in error, and that the structure is disordered. J. THEWLIS

GEOPHYSICS 55

550.341
6911. The form and laws of propagation of seismic wavelets. N. RICKER. *Proceedings of the third World Petroleum Congress, Section I. The Hague, 1951. Leiden, E. J. Brill (1951) pp. 514-36.*

Surveys briefly the theory of the propagation of a disturbance from a charge of dynamite in a homogeneous medium. The results of the theory are then compared with experimental results obtained for shale which are in excellent agreement with theory. The theory predicts that the centre of the wavelet travels with the velocity of elastic waves and that the breadth of the wavelet increases as the square root of the propagation time and also predicts the way in which the amplitudes of the particle displacement, velocity and acceleration waves decay. There is a discussion and a detailed bibliography. J. M. HOUGH

550.381
6912. Experimental confirmation of a mechanism of the reversal of thermoremanent magnetization. L. NÉEL. *C.R. Acad. Sci. [Paris]* 234, 1991-3 (May 12, 1952) In French.

Gives a theoretical discussion based on the author's work [Abstr. 8368 (1951)] of the experimental results of Nagata [Abstr. 5192 (1952)]. It is easy to understand the process of the reversal for a material containing two types of finely divided ferromagnetic constituents with differing Curie temperatures, the constituent with the higher Curie temperature being capable of exerting a demagnetizing field on the constituent with the lower Curie temperature, which field may exceed the applied field. The wider implications of the phenomenon are discussed.

E. P. WOHLFARTH

550.384
6913. On the direction of the geomagnetic field in the neighbourhood of Trèves about 380 A.D. E. THELLIER AND O. THELLIER. *C.R. Acad. Sci. [Paris]* 234, 1464-6 (March 31, 1952) In French.

Measurements were made of the direction of magnetization of 14 specimens taken from the walls of a Roman furnace near Trèves. The declination measurements show considerable dispersion which is attributed to local disturbance, but it is concluded that, at the time the furnace was abandoned, the declination in the neighbourhood was about 1°W and the inclination 61° . A. T. PRICE

550.384
6914. Movement of isoporic zero-lines for horizontal magnetic intensity in Sweden. K. MOLIN. *Arkiv Geofys.*, 1, 473-82 (Paper 17, 1952).

550.385 : 538.566.3 : 537.591 : 523.77
The chromospheric eruption of November 19, 1949 and its geophysical consequences.

550.839 : 539.16.08
6915. Aerial prospecting and the absorption of γ -radiation. J. F. STELJES; D. H. PEIRSON AND E. FRANKLIN. Letters in *Brit. J. Appl. Phys.*, 3, 203-4 (June, 1952).

A comment on the paper of Peirson and Franklin [Abstr. 9844 (1951)] together with the authors' reply. The correct value of the absorption coefficient for radium γ -rays is disputed and also whether it is valid to use signal/noise ratio to evaluate the experimental results. J. M. HOUGH

550.93 : 539.16
6916. Dating of relics by radiocarbon analysis. H. R. CRANE. *Nucleonics*, 9, 16-23 (Dec., 1951).

C^{14} is formed as a result of the absorption of cosmic ray neutrons in the nitrogen of the atmosphere. Biological matter, deriving its carbon from the atmosphere, starts with the same proportion of C^{14} isotope as the atmospheric carbon, but whereas the amount of C^{14} is in equilibrium in the atmosphere, in the solid matter, due mainly to lack of nitrogen, the proportion of C^{14} decreases due to radioactive decay. Thus the proportion of the C^{14} present is a measure of the time which has elapsed since the carbon was absorbed from the atmosphere. A counting technique for measuring C^{14} content is described. The carbon is purified by conversion to CO_2 and subsequently reduced over hot magnesium. It is then fabricated into cylindrical G.M. counter cathodes. A cathode of 300 cm^2 area with contemporary carbon gives 10 counts per minute above background, which can be kept down to about the same value by means of an anticoincidence arrangement to reduce cosmic-ray counts. The technique in use at present permits dating of samples to about 30 000 years in the past (5-6 half-lives of C^{14}). At one half-life (5568 ± 30 yr) the present accuracy is ± 350 yr. L. R. SHEPHERD

550.93 : 539.16
Extension of the carbon 14 age method. See Abstr. 6709

ATMOSPHERE . METEOROLOGY 551.5

551.508.77

6917. Compendium of meteorology. T. F. MALONE [EDITOR]. Boston, Massachusetts. *American Meteorological Society* (1951). 1315 pp. + Index.

551.5

"The purpose of the compendium is to summarize and appraise our knowledge of meteorology and to point the way to further advancement." 108 articles, by 102 well-known authors, each with its own bibliography, are arranged in 25 sections: Composition of the atmosphere; Radiation; Meteorological optics; Atmospheric electricity; Cloud physics; The upper atmosphere; Cosmical meteorology; Dynamics of the atmosphere; The general circulation; Mechanics of pressure systems; Local circulations; Observations and analysis; Weather forecasting; Tropical meteorology; Polar meteorology; Climatology; Hydrometeorology; Marine meteorology; Biological and chemical meteorology; Atmospheric pollution; Clouds, fog and aircraft icing; Meteorological instruments; Laboratory investigations; Radiometeorology; Microseisms.

551.507.321.2

6918. An experimental radiosonde for the investigation of the distribution of water vapor in the stratosphere. V. E. SUOMI AND E. W. BARRETT. *Rev. Sci. Instrum.*, **23**, 272-92 (June, 1952).

Following a short discussion of the limitations of the various types of balloon-borne radiosondes when used to gather information in the stratosphere, an analysis of the reasons for these limitations and some means for circumventing them are presented. It is shown that the choice of sensing element, or transducer, for temperature measurement is rather arbitrary so long as the element possesses a small lag coefficient and a high albedo. For pressure measurement it is shown that a nonlinear transducer, such as the hypsometer, with a sensitivity which increases at low pressure, is essential. For humidity measurement, only the condensation (dew point) technique is capable of giving meaningful data at great heights. The balance of the paper describes in detail a complete sounding instrument consisting of a hypsometer, a fine-wire thermo junction and a fully automatic electronic dew-point hygrometer, together with the necessary amplifier, radio telemetering equipment and internal calibration standard. The telemetering system is of special interest due to the relatively great accuracy obtainable with a very simple arrangement of components, utilizing only a modified Diamond-Hinman radiosonde. The instrument described in this paper has been flown to altitudes of over 30 km, using "Skyhook" plastic balloons; these flights yielded the first detailed pictures ever obtained of the moisture distribution in the stratosphere.

A.

551.508.19 : 621.317.79 : 621.396.11

6919. Automatic ionosphere recorder. J. M. CARROLL. *Electronics*, **25**, 128-31 (May, 1952).

A description, with electrical details and circuit diagrams, of the recorder used by the U.S. Bureau of Standards.

6920. A recording rain gauge. E. NOTHMANN. *J. Sci. Instrum.*, **29**, 229-30 (July, 1952).

Special care was taken to avoid the incorporation of sources of principal errors. It consists of two independent systems, one a self-balancing weighing beam for recording rainfall, and the other a float-chamber for automatic emptying, this being suspended on the load-side of the weighing beam and acting as rainwater receiver. Extensive tests of a prototype model have shown it to be accurate to more than 1% of its range. It is self-cleaning during each emptying process.

A.

551.508.29 : 536.531

6921. Performance characteristics of Sanborn rod thermistors. R. C. STALEY. *Bull. Amer. Met. Soc.*, **33**, 67-72 (Feb., 1952).

One type of Sanborn rod thermistor was studied with respect to the accuracy of measurement of air temperature. Compensation techniques are reviewed and inaccuracies, uncertainties and lag coefficients are evaluated. Shielding of thermistors from solar and long-wave radiation is examined. With yearly calibration and proper shielding, temperatures may be measured with an accuracy of at least 0.4°C.

A.

551.508.5 : 533.6.08

The design and development of three new types of gust anemometer. See Abstr. 6336

551.508.92

6922. The accuracy of visibility meters. N. G. BOLDYREV. *Izv. Akad. Nauk SSSR, Otdel Tekh. Nauk*, No. 12, 1786-91 (1951) In Russian.

Theoretical considerations lead to the conclusion that visibility meters measure the relative rather than the absolute contrast between an object and its background. The relative contrast is defined as the ratio of absolute contrast to the contrast giving threshold visibility. Careful selection and training of observers is necessary if the fullest accuracy is to be obtained.

F. QUELON

551.510.535

6923. Lunar stratification of the F2 layer at Huancayo, Peru. T. N. GAUTIER, R. W. KNECHT AND A. G. McNISH. *U.R.S.I. Proc. IXth Gen. Assembl.*, **8**, 216-21 (Pt II, 1950).

Evidence for daylight F2 layer stratification in winter showing strong dependence on the hour-angle of the moon. The vertical shift of the upper stratum is considerable, and is accompanied by continuous liberation of additional electrons underneath.

G. M. BROWN

551.510.535

6924. Study of the D layer by the method of Mirrick and Hentschel. I. PODLIASKY. *U.R.S.I. Proc. IXth Gen. Assembl.*, **8**, 247-50 (Pt II, 1950) In French.

Suggested measurement of the ionization density of the D layer by studying the distances between the interference fringes between the direct and reflected waves received at sea, or in an aeroplane, from a fixed kilometre-wave transmitter. The ratio of max. and min. intensities will also give the reflection coeff. of the D layer.

G. M. BROWN

551.510.535

6925. Meteoric echo study of ionospheric winds. L. A. MANNING, O. G. VILLARD, JR, A. M. PETERSON. Summary in *U.R.S.I. Proc. IXth Gen. Assembl.*, **8**, 191-2 (Pt II, 1950).

551.510.535

6926. Tidal phenomena in the ionosphere. *U.R.S.I., Spec. Rep. No. 2*, 72 pp. (1952).

A comprehensive report on the present state of knowledge in the subject. Topics discussed include the lunar and solar variations in the various ionospheric regions and the interpretation of these variations, the theory of atmospheric tides and of the perturbation of an ionized layer with and without a magnetic field present.

W. J. G. BEYNON

551.510.535

6927. Influence of local time on ionospheric perturbations. J.-M. ARDILLON. *C.R. Acad. Sci. [Paris]* **234**, 1568-71 (April 7, 1952) *In French*.

Examination of ionospheric storms over 2 years for Washington and Poitiers shows that the decrease of F_2 critical frequencies always begins at night. Sudden magnetic variations behave similarly. The amplitude of the perturbations, measured by the difference between the mean fF_2 on the 5 quiet and 5 disturbed days of a month, shows a diurnal and seasonal effect similar to that of the magnetic variations.

G. M. BROWN

551.510.535 : 538.566.3

Radio-wave propagation in the ionosphere. See Abstr. 6655

551.510.535 : 621.396.11

6928. Moon echoes and transmission through the ionosphere. F. J. KERR AND C. A. SHAIN. *U.R.S.I. Proc. IXth Gen. Assembl.*, **8**, 186-8 (Pt II, 1950).

Brief account extending earlier work [see Abstr. 2876 (1949)] of results obtained on 20 Mc/s. It is suggested that irregularities in the F -region make ionosphere penetration more difficult than orthodox ray theory predicts. The moon's libration provokes a type of fading in addition to that of ionospheric origin.

G. M. BROWN

551.510.535 : 621.396.11

6929. Behaviour of the E and F_1 layers. D. H. MENZEL AND J. G. WOLBACH. *U.R.S.I. Proc. IXth Gen. Assembl.*, **8**, 201-4 (Pt II, 1950).

Summary of analysis of variations of critical frequency (f_o) with solar zenith angle (θ) for many stations over the period 1943-48. It is found that the formula $\log f_o = \log f_z - p \log \cos \theta$ is valid for the E and F_1 layers so long as $\theta < 75^\circ$. Variations of the constants f_z and p with sunspot number and latitude are investigated, and it is found in general that they are more stable for the E than for the F_1 layer. Theoretical considerations show that f_z is related to the intensity of solar ionizing radiation, and p to the temp. gradient in the ionosphere.

G. M. BROWN

551.510.535 : 621.396.11

6930. Experimental investigation of the D -layer of the ionosphere. G. LEHMANN. *U.R.S.I. Proc. IXth Gen. Assembl.*, **8**, 235-8 (Pt II, 1950) *In French*.

Summary of possible techniques: critical frequency measurements on long waves and absorption of short waves. The influence of fluctuations may be elimi-

nated by recording the total power received (sum of the squares of the fields on two perpendicular aeri-als) in vertical sounding. Direct measurement of absorption is suggested by the use of rocket receivers and by recording the intensity of galactic noise. No quantitative results are given.

G. M. BROWN

551.510.535 : 621.396.67 : 621.396.11

6931. Note on the device consisting in adding the received power on two perpendicular aeri-als during vertical soundings. G. BOREL. *U.R.S.I. Proc. IXth Gen. Assembl.*, **8**, 243-7 (Pt II, 1950) *In French*.

Further consideration of the method of Lehmann (see previous abstract). It is shown theoretically that the power measured is independent of the phase variations of the two component rays.

G. M. BROWN

551.510.535 : 621.396.11

6932. Pulse studies of the ionosphere at low frequencies. R. A. HELLIWELL, A. J. MALLINCKRODT, F. W. KRUSE, JR, AND B. A. WAMBSGANSS. Abstract in *U.R.S.I. Proc. IXth Gen. Assembl.*, **8**, 212-14 (Pt II, 1950).

551.510.411

6933. The oxygen and water vapour balance of the atmosphere. H. LETTAU. *Z. Naturforsch.*, **7a**, 270-3 (March-April, 1952) *In German*.

The meteorological basis of von Harteck and Jensen's view regarding the formation of oxygen by photochemical decomposition of water vapour in the E -layer is discussed. The possibility of calculating the effective operation of these processes by vertical diffusion of H_2O vapour through the lower stratosphere is questionable. Von Harteck and Jensen's numerical reasoning is based on the moisture conditions in the lower stratosphere, but it contradicts meteorological observations obtained from soundings into the stratosphere. Their accepted values of humidity at 16 km are 10 times too large. The reality of the processes in a warmer, damper and strongly turbulent primeval atmosphere is possible, but further investigations are required.

R. S. READ

551.521.33

6934. On the effective transparency coefficient of the atmosphere. S. I. SIVKOV. *Dokl. Akad. Nauk SSSR*, **80**, 599-601 (No. 4, 1951) *In Russian*.

Q , the total amount of radiation falling on 1 cm^2 of a horizontal surface in the course of a cloudless day is given by an expression of the form $Q =$

$$I_0 \int_{-t_0}^{+t_0} \frac{1}{p^{\sin \lambda}} \sinh dt, \text{ where } p \text{ is the transparency coeff.}$$

of the atmosphere. Hitherto only approx. values have been obtained for Q , due to uncertainty as to the exact value of p . Approx. values can be obtained by using the values of p_{mid} . derived from Bug's equation $I_m = I_0 p_{mid}^m$. As the result of 14 years observations and 15 000 measurements at the Karadagskii Actinometric Observatory ($\phi = 44^\circ 54'$, $\lambda = 35^\circ 12'$, $H = 28 M$ above sea level) it has been shown that $p_{eff.}$ [i.e. the values of p that should be used to give true values for Q] differs from p_{mid} by approx. 0.023, i.e. $p_{eff.} = p_{mid} + 0.023 \dots (1)$. 0.023 is the average diff. over the whole year, it varies slightly from month to month and a table is given of the annual variation between $p_{eff.}$ and

*p*_{mid}. In order that (1) can be used widely, it is necessary to investigate variations of (1) with local conditions, particularly with regard to latitude.

W. HUGHES

551.543 : 550.38

6935. Atmospheric pressure and geomagnetic disturbance. R. P. W. LEWIS AND D. H. MCINTOSH. Letter in *Nature* [Lond.] **169**, 1059–60 (June 21, 1952).

Analyses of mean diurnal variation of atmospheric pressure at Aberdeen over each of two years of low sunspot number, 1934, 1942, associated with different magnetic activity (mean character figures, 0.56 and 0.65 respectively) indicate marked enhancement of forenoon max. in a year of higher magnetic activity compared with a year of lower activity, a result opposite to that found by Stagg (1931). A 365-day period appears too short to eliminate features of the diurnal pressure variation that are purely random from the standpoint of magnetic activity.

D. R. BARBER

551.576

6936. On the sampling of water droplets in natural clouds and in radiation fogs. J. MAZUR. Letter in *Proc. Phys. Soc.* [Lond.] **B**, **65**, 457–8 (June, 1952).

Discussion on the method described by Mason and Ludlam [Abstr. 7417 (1951)] of coating the sampling slide. It is suggested that a more satisfactory mixture is freshly melted mineral oil and vaseline.

J. M. HOUGH

551.593.9 : 535.338.4

6937. The airglow. G. M. BROWN. *Sci. Progr.*, **39**, 623–39 (Oct., 1951).

A review with bibliography of 46 items.

551.594.14

6938. On the existence of artificial radioactive products in rain water of the Parisian region. M. ABRIBAT, R. PINOIR, J. POURADIER AND A.-M. VENET. *C.R. Acad. Sci.* [Paris] **234**, 1161–3 (March 10, 1952). In French.

Rainwater was collected and evaporated and the residues then examined with a Geiger counter. It was shown that 8–15 days after an explosion of a bomb in Nevada the β -activity of the rain-water residues was much greater than normal. Further experiments with photographic plates showed that there was very little α -emission from the residues; this showed that the activity was due to artificial products and not to natural β -emitters. Decay curves for the activity suggest that the radioactive material is a complete mixture of radio elements.

J. M. HOUGH

551.594.21 : 538.566.2 : 621.396.9 : 621.396.11

6939. Distance determination to thunderstorm areas through the analysis of associated atmospheric waveforms. W. J. KESSLER AND C. W. GOYDER. *U.R.S.I. Proc. IXth Gen. Assembl.*, **8**, 316–22 (Pt II, 1950).

Location of thunderstorm areas at night is suggested by measuring from the waveform patterns of the lightning discharges the time intervals between the ground-propagated and ionosphere-reflected components of a parent pulse. During the daytime there is no ionosphere component due to *D*-region absorption. It is also suggested that lightning discharges

constitute natural pulses in the region 10–50 kc/s and hence may be used for v.l.f. ionosphere sounding.

G. M. BROWN

551.594.21 : 621.396.91

6940. The accuracy of the location of thunderstorms by cathode ray direction finders. F. HORNER. *U.R.S.I. Proc. IXth Gen. Assembl.*, **8**, 348–50 (Pt II, 1950).

Examination of the data from the British network of stations operating on 12 kc/s shows the presence of systematic (non-observational) errors of direction up to 10° at each station, in addition to random errors (with standard deviation ~2°). Irregularities of the sites are suggested as possible causes of the systematic errors.

G. M. BROWN

551.594.5 : 535.338.4

6941. Emission of hydrogen lines in the spectra of polar lights. I. S. SHKLOVSKIĖ. *Dokl. Akad. Nauk SSSR*, **81**, 367–70 (No. 3, 1951) In Russian.

Protons of solar origin yield neutral H atoms which are excited by collisions with atoms and molecules of the terrestrial atmosphere. The peculiarities of the elastic and non-elastic collisions of H atoms endowed with a velocity of *c*. 1000 km/sec can account for the penetration of these atoms to the height of 115–120 km (the usual level of polar lights). Contours of the H_{α} line observed in the spectrum of polar lights can be explained by assuming that corpuscles penetrating into the atmosphere have a broad velocity spectrum. The concentration of H atoms of solar origin is estimated at $[H] = 0.6 \text{ cm}^{-3}$ from the formula

$$I = \frac{h\nu}{4\pi} \int_{S_0}^{\infty} [H][N]\sigma dS = \frac{h\nu}{4\pi} [H]V\sigma \int_{S_0}^{\infty} [N]dS$$

where σ = the effective cross-section of excitation by collision with the atmospheric molecules, *V* — velocity of H atoms (1000 km/sec), *I* — intensity of H_{α} ($3 \times 10^{-4} \text{ erg/cm}^2 \text{ sec} \times \text{steradian}$), S_0 — lower limit of polar lights altitude (115 km), and $[N]$ — the concentration of molecules in the atmosphere.

F. LACHMAN

551.594.5 : 535.338.4

6942. Rotational temperatures of Vegard-Kaplan auroral bands. W. PETRIE. Letter in *Phys. Rev.*, **86**, 790 (June 1, 1952).

Measurements of rotational structure of 5 forbidden V–K auroral bands yield a mean temp. of 850°K. Higher dispersion may increase this figure. The result is to be contrasted with Vegard's measurements on the permitted N_2^+ auroral bands (350°K at 200 km level) and compared with particle density estimates (1000°K at 220 km).

G. M. BROWN

551.594.6 : 551.515.3

6943. The identification and tracking of tornadoes. H. L. JONES. *U.R.S.I. Proc. IXth Gen. Assembl.*, **8**, 296 (Pt II, 1950).

Suggestion from the spring tornado season in Oklahoma in 1949 that the accompanying lightning discharges are more violent than ordinary thunderstorms with an energy concentration in the blue end of the spectrum. Equipment that will only record "sferics" above a pre-set level might therefore be used for identifying tornadoes.

G. M. BROWN

551.594.6 : 551.594.221 : 538.565 : 621.396.822
6944. Some observations on the frequency spectrum of atmospheric disturbances due to thundercloud discharges and their effect on resonant circuits. F. W. CHAPMAN AND A. G. EDWARDS. *U.R.S.I. Proc. IXth Gen. Assembl.*, **8**, 351-4 (Pt II, 1950).

Experimental investigation of the effect of atmospherics, differing in magnitude and waveform, on circuits tuned in the range 1-25 kc/s. It is found that in the intermittent lightning flash consistent build-up of energy does not take place at any one frequency for more than a few milliseconds; but the quasi-periodic type of atmospheric shows a strong build-up at frequencies < 6.6 kc/s (when the ionosphere-reflected component is strong).
 G. M. BROWN

551.594.6 : 551.594.22
6945. On the waveform of atmospherics due to thundercloud discharges. F. W. CHAPMAN. *U.R.S.I. Proc. IXth Gen. Assembl.*, **8**, 355-9 (Pt II, 1950).

Summary article concerning various opinions as to the origin of the observed waveform of atmospherics, together with an account of 3 years' work covering day and night observations of the effects of the ground and the ionosphere on the waveforms for sources distant 100 to 2000 km.
 G. M. BROWN

551.594.6 : 621.396.822
6946. A survey of the atmospheric noise problem. R. S. HOFF AND A. W. SULLIVAN. *U.R.S.I. Proc. IXth Gen. Assembl.*, **8**, 297-302 (Pt II, 1950).

Accuracy of noise prediction is conditional on (1) proper statistical analysis of data, and (2) proper allowance for limitations of noise meters (amplifier response, aerial response, etc.). Some consideration is given to (1).
 G. M. BROWN

551.594.6 : 621.396.822
6947. A statistical study of the sources of atmospherics in Europe and the North Atlantic. P. DOURY. *U.R.S.I. Proc. IXth Gen. Assembl.*, **8**, 338-40 (Pt II, 1950) *In French*.

Maps have been drawn indicating the distribution of the frequency of occurrence of atmospheric noise over the period Dec. 1944 to Dec. 1948 for each month. It appears that corresponding months present the same characters in successive years. The geographical location and intensity of sources of noise are discussed for summer and winter periods.
 G. M. BROWN

551.594.6 : 621.396.822
6948. A comparison between predicted and observed levels of atmospheric noise. F. HORNER. *U.R.S.I. Proc. IXth Gen. Assembl.*, **8**, 346-8 (Pt II, 1950).

Comparison of maximum noise levels on 2.5 Mc/s for 6 stations with the predicted values shows that in all cases the observed seasonal variation is greater than predicted, while the predicted annual mean values are too low for stations near the main storm centres and too high for those remote from the centres.
 G. M. BROWN

551.594.6 : 621.396.93
6949. Extension to atmospheric radio direction finders of the definition of the threshold of action by an impulse flux. F. CARBENAY. *U.R.S.I. Proc. IXth Gen. Assembl.*, **8**, 329-31 (Pt II, 1950) *In French*.

Earlier work [Abstr. 7667 (1950)] defining the threshold of action of an automatic receiver for recording the mean level of atmospherics by an impulse flux is extended to the case of radio direction finders of atmospherics.
 G. M. BROWN

BIOLOGY 57/59

576.353 : 537.531
6950. The rate of appearance of neutrocytes in mitosis after general irradiation with a single dose of X-rays. J.-F. DUPLAN. *C.R. Acad. Sci. [Paris]* **234**, 2020-2 (May 12, 1952) *In French*.

After whole-body irradiation of guinea pigs with single doses of 180 kV X-rays, it is found that the number of neutrophil polymorphonuclear cells having mitotic nuclei, increases. The larger the X-ray dose, the more rapid is this increase, and the earlier the maximum occurs. Details of experimental arrangements and the doses used are given. Graphs indicate the effects described.
 D. V. MABBS

577.39 : 539.16
6951. Actions of radiations on living cells, 1946 and after. L. H. GRAY. *Brit. J. Radiol.*, **25**, 235-44 (May, 1952).

Lea's work on the "target theory" and its limitations are outlined, and experiments are described which have added further knowledge on the action of radiation since 1946. These have shown (1) that there is an increased action on bacteriophage with time delay after irradiation, pointing to effect of H_2O_2 , (2) exposure to light produces a recovery (about 25%) after irradiation of organisms with u.v., (3) radio-mimetic

agents cause the same kind of damage as ionizing radiations, but are more mild and more specific in their action. (4) absence of O_2 reduces the number of chromosome breaks due to X-rays but not those due to α -rays, supporting the view that H_2O_2 plays a part in causing these breaks.
 F. T. FARMER

578.088.5
6952. Hypothesis of the biological action of radiation. M. KIGA. *Science*, **115**, 549-50 (May 16, 1952).

Results of investigations on the effect of radiations on living organisms, lend themselves to clarification mathematically. With viruses, exponential survival curves are typical. With bacteria, and cells of higher organisms, the curves are of sigmoid type. The multihit theory of Blau and Altenburger is here modified by assuming that there are, in a cell, n molecules essential to its existence, and that cell survival is possible if no more than r of these are damaged. A mathematical expression for the survival curve, giving an exponential or sigmoid according to values of n and r , is evolved. When delayed cell division is considered r/n will be a function of the time of irradiation, and the hypothesis interprets Lea's concept of the cumulative dose.
 D. V. MABBS

MEDICAL SCIENCE . HUMAN PHYSIOLOGY 61

611.77

6953. Spectral reflectance of white and negro skin between 440 and 1000 m μ . H. F. KUPPENHEIM and R. R. HEER, JR. *J. Appl. Phys.*, **4**, 800–6 (April, 1952).

The spectral reflectance of the human skin was recorded over an extended range from 431 to 1000 m μ on a large number of white and negro subjects under varied tan conditions; the results were evaluated statistically. The maximum reflectance was found between 720 and 820 m μ on the least tanned white skin. It shifted towards greater wavelengths with increased pigmentation; on the heavily tanned negro skin it was found at 900 m μ . Three reflectance minima, probably due to water absorption bands, were found; one near 760 m μ and another one near 845 m μ , both of which became progressively masked with increased pigmentation; the third minimum, at 980 m μ , was strongly pronounced but only slightly influenced by the degree of pigmentation. The difference in spectral reflection of untanned and tanned skin as well as of white and negro skin tends to disappear with increasing wavelength. A.

612.014.424 : 621.3.012.8

6954. Experimental investigations on the electrical resistance of the human body. C. E. SÖDERBAUM. *Bull. Ass. Suisse Elect.*, **43**, 110–15 (Feb. 23, 1952) In German.

The test were made with d.c. and a.c. of about 10 V with ammeters and voltmeters and with a c.r.o. using dry and wet electrodes. They showed the strong dependence of the resistance on the emotional state of the person under test. Consideration of the test results led to an equivalent circuit of the human body consisting of two conducting paths. The one comprises ohmic resistances of the skin, the liquid parts of the body and the tissues. The other, also going through the skin, passes capacitively to the nervous system. Thus the cramp originated by a.c. is explained. It is particularly marked with wet bodies so that even small voltages may become dangerous. A method could probably be found for preventing the heart flicker by influencing the exciting and calming nerves controlling the frequency of the heart beats by the use of suitable electrodes and sources of current.

R. NEUMANN

612.014.462.481 : 575

6955. Radiation genetics. I. Genetic aspects of radiation risks. A. HOWARD. *Brit. J. Radiol.*, **25**, 177–9 (April, 1952).

Symposium at the 6th International Congress of Radiology, London, July (1950). See also two abstracts following. A review of the experimental work on radiation-induced mutation in relation to the policy of the amount of ionizing radiation permissible on medical grounds. Agreeing in principle with Muller that any increase in mutation rate is probably undesirable, it is essential to protect the gonads of those exposed to radiation. As long as the addition is very small in terms of the average of the whole population, the effect even after many exposed generations may be negligible. Since, however, it is impossible (as yet) to control or direct mutation there is no way, for the human species, of

undoing the damage and measures must be directed to the avoidance as far as possible of any increase of mutation rate.

T. A. CHALMERS

612.014.462.481 : 575

6956. Radiation genetics. II. Indirect effects of X rays on chromosomes. G. BONNIER. *Brit. J. Radiol.*, **25**, 180–2 (April, 1952).

On the basis of the "target theory" for the mutagenic effect of X-rays it would be expected that there should be a linear dependence of mutation frequency upon dosage measured in rontgen units. G. Bonnier and K. G. Lüning *Hereditas*, **35** 163 (1949) found that upon extrapolating the straight line to zero dose, the frequency was higher than that found to occur spontaneously; as a result it was assumed that the relation between mutation rate and dose is curvilinear for small doses. Since then indirect effects of X-rays have been found to occur in *Drosophila* in the production of gynandromorphs and now a study has been made of the frequencies of gynandromorphs produced by X-rays and with sulphur mustard gas.

T. A. CHALMERS

612.014.462.481 : 575

6957. Radiation genetics. III. A cytological and cytochemical approach to an understanding of radiation damage in dividing cells. A. H. SPARROW, M. J. MOSES and R. STEELE. *Brit. J. Radiol.*, **25**, 182–9 (April, 1952).

The cytological material used was meiotic and post-meiotic cells of *Trillium erectum* L. and the chromosome fragmentation was used as a measure of radiation damage after irradiation by doses of 50 r of X-rays generated at 160 kV. It is shown that the sensitivity to chromosome breakage by X-rays increases during meiotic prophase to a peak at or near diplotene and then decreases gradually to a low point in early interphase. The change in sensitivity is at least sixty-fold. It has also been shown that the amount of rejoining which occurs at different stages is of some importance in determining apparent sensitivity. Furthermore, it has been shown that the period of increase of desoxypentose nucleic acid is a period of increasing sensitivity.

T. A. CHALMERS

612.843.2

6958. Sensations produced in the eye by short luminous excitations. H. JURIGIC. *Rev. Opt. (Théor. Instrum.)* **31**, 177–85 (April, 1952).

Series of photometric measurements on 30 subjects to evaluate the apparent luminance of a small point that appears in the foveal field for a very short time. An attempt is made to deduce the laws of time-variation of the light sensation during its build-up period, the regions of proportionality, Broca's undulation, and return to equilibrium. A.

612.843.31

6959. A component of the human electroretinogram associated with red color vision. J. C. ARMINGTON. *J. Opt. Soc. Amer.*, **42**, 393–401 (June, 1952).

A recently discovered component of the human electroretinogram (the electrical response wave resulting from stimulation by light) is recorded with an electrode mounted in a contact lens. Although previous investigators have thought it to be a photopic response, this component of the ERG is found to have

a spectral sensitivity function that is maximal at approximately 630 m μ and is not similar to either a photopic or a scotopic luminosity function. This component is absent in the eyes of protanopes (red colour blind) but present in eyes characterized by other forms of colour deficiency. It increases rapidly with dark adaptation and is greatest after approximately one minute in darkness. It is accompanied by several new and previously unreported waves which also make their appearance during the early stages of dark adaptation. This research provides direct physiological evidence for a peripheral locus of colour blindness and for a specific red colour mechanism.

A.

612.843.32 : 535.61

6960. Study of the conspicuity of orange surface colors. W. E. K. MIDDLETON. *Illum. Engng [N.Y.]* 47, 95-8 (Feb., 1952).

A particular paint, aviation orange, is used for marking obstructions at airports. This paper describes a full-scale investigation to determine whether, in fact, this colour is the most conspicuous. Six colours, covering a range on both the yellow and the red sides of this orange were used and were viewed against a variety of backgrounds. It is concluded that, on the average, aviation orange is the most conspicuous and that yellow is least satisfactory.

J. W. T. WALSH

612.843.63

6961. The effect of pupil size on visual acuity for photometrically equated test fields at various levels of luminance. H. LEIBOWITZ. *J. Opt. Soc. Amer.*, 42, 416-22 (June, 1952).

Visual acuity for a grating test object was determined as a function of artificial pupil diameter at 5 luminance levels. In order to eliminate the effect of variation of retinal illuminance with pupil size changes as a factor in acuity, the luminance of the acuity test field as viewed through each artificial pupil was previously adjusted to match a reference field of constant luminance viewed by the other eye through a fixed pupil at 5 luminance values of the reference field. Selection of maximum artificial pupil size was made on the basis of photographs of the natural pupil taken under conditions similar to those which obtained in the main experiment. As pupil size is increased, acuity improves rapidly at first and then more slowly before reaching a maximum value of acuity. Further increase in pupil size, when possible, results in lowered acuity. The rise in acuity up to the maximum is steeper the higher the luminance level, whereas the drop in acuity which occurs when the pupil is made even larger is steeper the lower the luminance level. The results are interpreted as reflecting the increased importance of aberrations as a factor in acuity as pupil size is increased and the luminance level is lowered. The data are plotted to show the effect of pupil size as a parameter of the acuity-reference luminance function.

A.

612.843.72

6962. An illusion of depth due to opaque and translucent figures drawn on glass. A. REY. *Arch. Sci.*, 4, 374-82 (No. 6, 1951) In French.

When opaque and translucent lines are drawn on a piece of glass and illuminated from behind, the opaque

ones appear generally to lie in front of the others. Red lines produce a more marked illusion than blue or green. The effect is observed under various conditions and appears also with monocular vision. [This suggests an explanation of a psychological nature.]

R. A. WEALE

612.855

6963. Gross localization of the place of origin of the cochlear microphonics. G. v. BÉKÉSY. *J. Acoust. Soc. Amer.*, 24, 399-409 (July, 1952).

An apparatus was developed that made it possible to push an electrode automatically with an absolutely even and smooth velocity through the cochlear partition of an anesthetized guinea pig. The a.c. and d.c. potentials of this perforating electrode were recorded during the perforation when sound was applied to the ear-drum, or when an electrical generator was connected to the vestibular and tympanic channels of the cochlea. These measurements enable us to show that the endolymph is surrounded by an electrically insulating layer, and that the inner part of the organ of Corti is protected from external electrical potential fields. Further, it was shown that the microphonics produced by a vibration of the eardrum have larger values inside the endolymph than in the perilymph or near the round window. The microphonics seem to reach a maximum near the organ of Corti. The perforation measurements also made it possible to discriminate three types of tissues in the cochlea: (1) highly sensitive cells with large microphonics and d.c. potentials; (2) cells that do not produce large microphonics but still have in them large d.c. potentials; and (3) tissues that are electrically indifferent and can be represented by an electrical resistance. These distinctions and the measurement of the electrical conductivity of the endolymph permit a coarse description of the electro-anatomy of the cochlear partition.

A.

612.855

6964. The impedance of the human mastoid. E. K. FRANKE. *J. Acoust. Soc. Amer.*, 24, 410-11 (July, 1952).

The impedance of the human mastoid was determined by means of a vibrating piston, one end of which was placed in firm contact with the body surface. The impedances of several subjects were measured. The compliance c and the resistance r were calculated from the results; the average values were $c = 1.5 \times 10^{-8}$ cm/dyne and $r = 1.0 \times 10^4$ dyne/cm/sec. for an area of the piston base of 1 cm² and an application force of 250 g. It is shown how the impedance depends on the area and the application force of the piston. A critical review of the literature on this subject is given.

A.

612.858.7

6965. Physical questions and viewpoints on the diagnostic measurement of noise-masking in the ear. F. J. MEISTER. *Akust. Beih.*, No. 2, AB49-AB58 (1952) In German.

Since the important investigations of H. Fletcher and W. A. Munson the measurement of masking has gained importance, especially for the identification of disturbances of the inner ear. A method of measurement of noise masking is shown in the course of which the different regions of the basilar membrane

can be treated independently. The noise spectrum used has an outline figure lying symmetrically to the masked frequency. It can be shifted in octave steps along the frequency scale like the usual audiometer frequencies (c-scale), the outline figure being preserved. The procedure may be used for recording audiograms either with or without help of masking. For recordings in the auditory sphere, fatigue plays an important part. The association between masking and fatigue is shown by displacements of thresholds, recorded shortly after the noise-treatment of the ear, i.e. in the transitional stage immediately after the treatment. This transition period was made as short as possible (shorter than the time of equilibration). Displacements of thresholds corresponding to the masking figures are given as a result; obviously these displacements are residuals of the masking. Their influence on recordings of the recruitment, especially on monaural measurement, must not be neglected. This influence expresses itself in anomalous curvature of the increase of loudness in measuring masking with growing sound intensity, which simulates a recruitment. This is shown by examples. These mistakes can be avoided or reduced by quick steps of measurement or by uniformity, i.e. mechanization of the measurement.

A.

614.48 : 537.531

6966. A new after-effect of X-rays on dilute aqueous suspensions of bacteriophage. T. ALPER. Letter in *Nature [Lond.]* 169, 964-5 (June 7, 1952).

Inactivation continues after irradiation, and in 1 hr the phage count is reduced to 1/10. This appears to be due to increased susceptibility to the H_2O_2 produced in the aqueous suspension; it exceeds by far the effect of the same amount of H_2O_2 on the unirradiated phage.

F. T. FARMER

614.898

6967. Room-protection measurements for cobalt-60 teletherapy units. W. R. DIXON, C. GARRETT AND A. MORRISON. *Nucleonics*, 10, 42-5 (March, 1952).

Experiments were carried out with a broad beam of γ -radiation from a Co^{60} source giving 22 r/min at 1 metre. Absorption measurements in concrete ($\rho = 2.37$) and Pb were made both for the direct beam and radiation scattered at various angles from a masonite phantom and concrete walls. The angular distributions of the scattered radiation were also investigated. On the basis of the results it is possible to specify suitable thicknesses of Pb or concrete walls for rooms used in Co^{60} therapy.

L. R. SHEPHERD

614.898

6968. Monitoring of a diagnostic X-ray department. L. E. JACOBSON, J. J. SCHWARTZMAN AND S. HEISER. *Radiology*, 58, 568-82 (April, 1952).

Results are presented of a survey in one hospital of stray radiation to which staff are exposed in both routine diagnostic work and in a number of special diagnostic procedures.

H. MILLER

614.898

6969. The RADIAC slide rule for the computation of external radiation dose from nuclear fission products. B. W. SOOLE. *J. Sci. Instrum.*, 29, 189-92 (June, 1952).

The danger to persons exposed to nuclear radiations from fission products deposited after an atomic explosion cannot be fully estimated from a measure-

ment of the ionization dose-rate at any particular time because the intensity of ionization decreases continually, and the rate of decrease depends on the age of the fission products. A slide-rule is described by means of which this decay can be allowed for quickly and accurately.

A.

614.898

6970. X-ray protection design. H. O. WYCKOFF AND L. S. TAYLOR. *Handb. U.S. Bur. Stand.*, No. 50, 36 pp. (1952).

The handbook contains factual data and the basic principles necessary for designing shielded X-ray installations, based on the recommendations of the U.S. National Committee on Radiological Protection. Figures for absorption in Pb and concrete for direct X-ray beams of 75 kV-2 MeV are given. Protection for persons working with the equipment, and also in adjoining areas, is considered. Typical cases are discussed together with plans for protecting treatment rooms, and many examples illustrate the fundamental principles involved.

D. V. MABBS

615.849

6971. On the action of X-ray upon the serum proteins. M. WAKABAYASHI AND F. KAWAMURA. *Monogr. Ser. Res. Inst. Appl. Elect.*, No. 2, 1-10 (1951).

The experimental irradiation of proteins of normal human sera by X-rays with doses ranging from 10^5 to 10^6 r generated at 90 kVp produced changes in the electrophoretic patterns and obvious changes on protein sulfhydryl group, ammonium group and tyrosine group. The mechanism during these changes is explained on the "target theory."

T. A. CHALMERS

615.849

6972. Depth dose curves for grids in X-ray therapy. R. LOEVINGER. *Radiology*, 58, 351-60 (March, 1952).

A method is presented for analysing therapy depth doses into a primary and scattered fraction. It is shown that this makes it possible to compute the maximum and minimum depth doses which will occur with the use of the treatment grid. The ratio of maximum to minimum is large at the surface (5 to 7) but drops rapidly at a depth, due to scattered radiation.

A.

615.849

6973. Depth dose investigation for perforated grid therapy at 200 kilovolts. L. E. JACOBSON AND A. LIPMAN. *Amer. J. Roentgenol. Radium Ther.*, 67, 458-69 (March, 1952).

Measurements along the lines of direct beam and of shadow under a grid of 1 cm pitch were made with a Victoreen dosimeter, using the 250 r chamber in a Presdwood phantom. The chamber was localized radiographically and average values for the depth-dose under a 50% open grid were determined. These were found to be slightly less than for plain fields under the same conditions of irradiation.

F. T. FARMER

615.849

6974. The grid technique of radiotherapy with depth dose measurements. O. H. COHEN AND W. L. PALAZZO. *Amer. J. Roentgenol. Radium Ther.*, 67, 470-6 (March, 1952).

Depth dose measurements for grids of 1 and 2 cm pitch at 200 kV were made with photographic film in a Presdwood phantom. The average values obtained for a 50% open grid, as well as those in the lines of

shadow at depths below 5 cm, are found to be appreciably greater than for plain fields under the same conditions of irradiation.

F. T. FARMER
615.849

6975. Physical observations relating to the 2 MeV Van de Graaff electrostatic generator at Westminster Hospital. C. W. WILSON and B. J. PERRY. *Brit. J. Radiol.*, **25**, 210-19 (April, 1952).

Measurements of dose distribution for varying size and shape of field were made photographically and the build-up beneath the surface was found with a thin walled ionization chamber. This has a maximum at 0.4 cm depth. The quality of radiation at 2 MeV is 12.6 mm Cu H.V.L. and output 76 r/min at 250 μ A at 1 m distance. Beam movements of ± 4 mm at the treatment distance have been observed. Protection measurements both within and outside the treatment room are included.

F. T. FARMER

616.07 : 535.37 : 539.16.08

6976. Selective accumulation of fluorescent and radioactive dyes in tumour tissue as a basis of a new method of cancer diagnosis. H. CRAMER, W. STITCHEL and A. TREIBS. Note in *Naturwissenschaften*, **39**, 137-8 (No. 6, 1952) In German.

The application of P^{32} to clinical tumour diagnosis requires the introduction of a miniature G.M. counter, since the β -rays of P^{32} have only a range of 8-11 mm in human tissue. I^{131} which is a γ -emitter that can be detected externally has been combined in di-iodo-131-deuteroporphorin and di-iodo 131 fluorescein for both radioactive and fluorescent measurements. The dyes of the acridin series (acridin-Orange, Atebrin, etc.) and Na fluorescein have now been applied to tumour diagnosis by their delayed excretion in urine as measured by a Beckmann spectral photometer at a definite wavelength. T. A. CHALMERS

TECHNICAL MATERIALS 66/67

666.1/2

6977. Tellurite glasses. J. E. STANWORTH. Letter in *Nature* [Lond.] **169**, 581-2 (April 5, 1952).

Oxide glasses with TeO_2 as the main component are found to have unusual properties: (a) low expansion

sivities ($\sim 17 \times 10^{-6}$), (b) low transformation temperatures ($\sim 300^\circ C$), (c) high refractive indices (~ 2.1 for 5780 Å), (d) high permittivities (~ 27), (e) low absorption of infrared up to $\sim 5\mu$ wavelength.

R. O. DAVIES

PHOTOGRAPHY 77

771.531 : 535.247.1

Photometric papers sensitive only to short wave ultraviolet. See Abstr. 6365

771.534.59 : 537.591.8

6978. On the influence of cosmic rays on X-ray films during storage. R. H. HERZ. *Photogr. J. B*, **91**, 134-6 (Nov.-Dec., 1951).

Two types of X-ray films were stored for 6 and 12 months: (a) underground (water equivalent 60 m); (b) at sea level. The fog due to cosmic rays in one year ≈ 0.06 (about half the total), which corresponds to the amount calculated on the bases of the known number of ions/cm² sec produced in air by cosmic rays.

778.3 : 537.542

Nuclear emulsion and scintillation crystal processes. See Abstr. 6585

778.34 : 537.533.75

Grain density in tracks of electrons moving at relativistic velocities in photographic emulsions. See Abstr. 6561

778.0

6979. The resolving power of three layer colour films. J. EGGERT and W. GROSSMAN. Note in *Naturwissenschaften*, **39**, 132-3 (No. 6, 1952) In German.

The resolving power of the three separate layers has been determined for 14 commercial colour emulsions. Apart from the case of Eastman colour positive film, which has an exceptional structure, the plot of resolving power against depth of the layers from the surface shows that all the points lie close to a straight line. It is concluded that the resolution depends solely on light scattering in the layers, and is not affected by the varying means of producing the colours in different types of emulsion. S. T. HENDERSON